M20™ Internet Router

Hardware Guide

M20 Internet Router Hardware Guide

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About This Manual

This chapter provides a high-level overview of the *M20 Internet Router Hardware Guide*:

- Objectives on page xvii

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Objectives

This manual explains the hardware installation and basic troubleshooting for the M20 Internet router. It contains procedures for preparing your site for router installation, unpacking and installing the hardware, starting up the router, performing initial software configuration, and doing routine maintenance and upgrades. After completing the installation and basic configuration procedures covered in this manual, refer to the JUNOS Internet software configuration guides for information about further configuring the JUNOS software.

To obtain additional information about Juniper Networks Internet routers and their PICs—either corrections to information in this manual or information that might have been omitted from this manual—refer to the hardware release notes.

To obtain the most current version of this manual, the most current version of the hardware release notes, and other Juniper Networks technical documentation, refer to the product documentation page on the Juniper Networks Web site, which is located at http://www.juniper.net.

To order printed copies of this manual or to order a documentation CD-ROM, which contains this manual, please contact your sales representative.

Audience

This manual is designed for network administrators who are installing and maintaining a Juniper Networks router, or preparing a site for router installation. It assumes that you have a broad understanding of networks in general, the Internet in particular, networking principles, and network configuration. Any detailed discussion of these concepts is beyond the scope of this manual.

Document Organization

This manual is divided into several parts, each containing a category of information about the router:

- Part 1, "Product Overview," provides an overview of the router, describing its hardware components, the JUNOS Internet software, and the system architecture.

- Part 2, "Initial Installation," describes how to prepare your site for installing the router, providing environmental and power supply specifications, rack and clearance requirements, and wiring and cabling guidelines. It also provides an overview of the installation process, lists safety guidelines, and describes how to unpack the router. Finally, it explains how to install the router chassis and components and how to initially start the router and configure the software.

- Part 3, "Hardware Maintenance and Replacement Procedures," provides general maintenance procedures for the router and describes how to maintain and replace the router components.

- Part 4, "Troubleshooting," describes general troubleshooting procedures for the router and explains how to track the source of problems in the hardware components. It also tells you how to contact the Juniper Networks Technical Assistance Center (JTAC).

- Part 5, "Appendixes," provides an appendix with instructions on returning the router or its components, an appendix of pinout specifications for several cable types, instructions for cleaning fiber-optic cable connector ports, and an appendix of glossary terms.

- Part 6, "Index," provides an index of the manual.

Related Documents

For more information about Physical Interface Cards (PICs) for the M20, see the *M20 Internet Router PIC Guide*.

For information about configuring the software, including examples, see the following documents:

- JUNOS Internet software configuration guides

- *JUNOS Internet Software Operational Mode Command Reference*

- *JUNOScript API Guide* and *JUNOScipt API Reference*

Documentation Conventions

This manual uses the following text conventions:

- Router and router component labels are shown in a sans serif font. In the following example, ETHERNET is the label for the Ethernet management port on the router:

    The 10/100-Mbps Ethernet RJ-45 connector is used for out-of-band management of the router and is labeled ETHERNET.

- Statements, commands, filenames, directory names, IP addresses, and configuration hierarchy levels are shown in a sans serif font. In the following example, stub is a statement name and [edit protocols ospf area *area-id*] is a configuration hierarchy level:

    To configure a stub area, include the stub statement at the [edit protocols ospf area *area-id*] hierarchy level.

- In examples, text that you type literally is shown in bold. In the following example, you type the words **show chassis alarms**:

    For example, you can use the following command to get information about the source of an alarm condition:

    user@host> **show chassis alarms**

Notes, Cautions, and Warnings

Notes, cautions, and warnings are denoted by the following symbols:

> **Note**
> A note indicates information that might be helpful in a particular situation, or information that might otherwise be overlooked.

> **Caution**
> A caution indicates a situation that requires careful attention. Failure to observe a cautionary note could result in minor injury or discomfort to yourself, or serious damage to the router.

> **Warning**
> A warning indicates a potentially dangerous situation. Failure to follow the guidelines in a warning could result in severe injury or death.

Contact Juniper Networks

For technical support, contact Juniper Networks at support@juniper.net, or at 1-888-314-JTAC (within the United States) or 408-745-2121 (from outside the United States).

Documentation Feedback

We are always interested in hearing from our customers. Please let us know what you like and do not like about the product documentation, and let us know of any suggestions you have for improving the documentation. Also, let us know if you find any mistakes in the documentation. Send your feedback and comments to tech-doc@juniper.net.

Part 1
Product Overview

1

M20 Internet Router Hardware Guide

Chapter 1
System Overview

This chapter provides an overview of the M20 Internet Router, discussing the following topics:

- System Description on page 3

- Field-Replaceable Units (FRUs) on page 4

- Component Redundancy on page 4

- Safety Requirements, Warnings, and Guidelines on page 5

- System Specifications on page 5

System Description

The M20 Internet Router provides high-speed interfaces for large networks and network applications, such as those supported by Internet backbone service providers.

Application-specific integrated circuits (ASICs), a definitive part of the router design, enable the router to achieve data forwarding rates that match current fiber-optic capacity.

The router accommodates up to four Flexible PIC Concentrators (FPCs), each of which can be configured with a variety of network media types—all together providing up to 64 physical interface ports per system.

The router architecture cleanly separates control operations from packet forwarding operations. This design eliminates processing and traffic bottlenecks, permitting the router to achieve high-performance transfer rates. Control operations in the router are performed by the Routing Engine, which runs JUNOS Internet software to handle routing protocols, traffic engineering, policy, policing, monitoring, and configuration management. Forwarding operations in the router are performed by the Packet Forwarding Engine, which consists of hardware, including ASICs, designed by Juniper Networks.

The router's maximum aggregate throughput is 20 Gbps. The router can forward traffic at high-performance rates for any combination of Physical Interface Cards (PICs) that does not exceed 3 Gbps on a single FPC. Any combination that exceeds 3 Gbps is supported, but constitutes oversubscription.

The router is a modular, rack-mountable system. It is 14 in. (36 cm) high, 19 in. (48 cm) wide, and 21 in. (54 cm) deep. Its size allows up to five routers to be installed in one standard, 78-inch (198.1 cm) high telco rack. A fully populated router weighs approximately 134 lb (61 kg).

Field-Replaceable Units (FRUs)

FRUs are router components that can be replaced at the customer site. Replacing FRUs requires minimal router downtime. There are two types of FRUs:

■ Hot-insertable and hot-removable FRUs—You can remove and replace these components without powering down the router or disrupting the routing functions.

■ Hot-pluggable FRUs—You can remove and replace these components without powering down the router, but the routing functions of the system are interrupted when the component is removed.

Table 1 lists the FRUs for the router.

Table 1: Field-Replaceable Units

Hot-removable and hot-insertable FRUs	Hot-pluggable FRUs
Flexible PIC Concentrators (FPCs)	Routing Engine
Physical Interface Cards (PICs)	System and Switch Board (SSB)
Power supplies	
Front and rear impeller assemblies	
Fan trays	
Craft Interface	

For FRU replacement instructions, see "Hardware Maintenance Overview" on page 131.

Component Redundancy

The router is designed so that no single point of failure can cause the entire system to fail. The following major hardware modules are redundant:

■ Routing Engine and SSB—If there is a Routing Engine or SSB failure, the redundant Routing Engine or SSB immediately assumes routing functions.

■ Power supplies—The router has two power supplies, which share the load evenly. If one of the power supplies fails, the second power supply can supply full power to the router's components.

■ Cooling system—The cooling subsystems have redundant components, which are controlled by the SSB. If a fan fails, the remaining fans provide sufficient cooling for the unit indefinitely.

Safety Requirements, Warnings, and Guidelines

Many of the procedures for installing and maintaining the router involve working with electrical components. While it is assumed that you have a working knowledge of safety requirements necessary in working with Internet routers, you also need know the procedures for working safely with or near electrical equipment. A more detailed description of the hazards associated with working with the router is provided in "Regulatory Compliance and Safety Information" on page 57, but specific guidelines for working with electrical equipment are beyond the scope of this manual.

System Specifications

The router's physical and environmental specifications are listed in Table 2.

Table 2: Physical and Environmental Specifications

Description	Value
Chassis height	14 in. (36 cm)
Chassis width	19 in. (48 cm)
Chassis depth	21 in. (54 cm)
Weight, maximum configuration	134 lb (61 kg)
Weight, minimum configuration	80 lb (36 kg)
Altitude	No performance degradation to 10,000 ft (3048 m)
Relative humidity	Normal operation ensured in relative humidity range of 5 % to 90 %, noncondensing
Temperature	Normal operation ensured in temperature range of 32°F to 104°F (0°C to 40°C)
Shock	Tested to meet Bellcore Zone 4 earthquake requirements
Thermal output	3850 BTU/hour

Chapter 2
Hardware Component Overview

This chapter provides an overview of the M20 Internet Router hardware components:

Chassis

The router chassis is a rigid sheet metal structure that houses all the other router hardware components (see Figure 1 and Figure 2). The chassis is 14 in. (36 cm) high, 19 in. (48 cm) wide, and 21 in. (54 cm) deep. The chassis has a mounting system that installs into standard 19-in. equipment racks or telco center-mounted racks and allows multiple routers to be installed into one standard, 78-in. (198.1 cm) high rack.

The chassis contains the following components:

■ Two electrostatic discharge points (banana plug receptacles), one front and one rear

■ Front-mounting metal ears on either side, used to bolt the chassis to the rack

■ Optional 19-in. (48 cm) rack-mounting ears for telco center-rack mounting

■ Optional front-mounting brackets

Figure 1: Rear View of Chassis
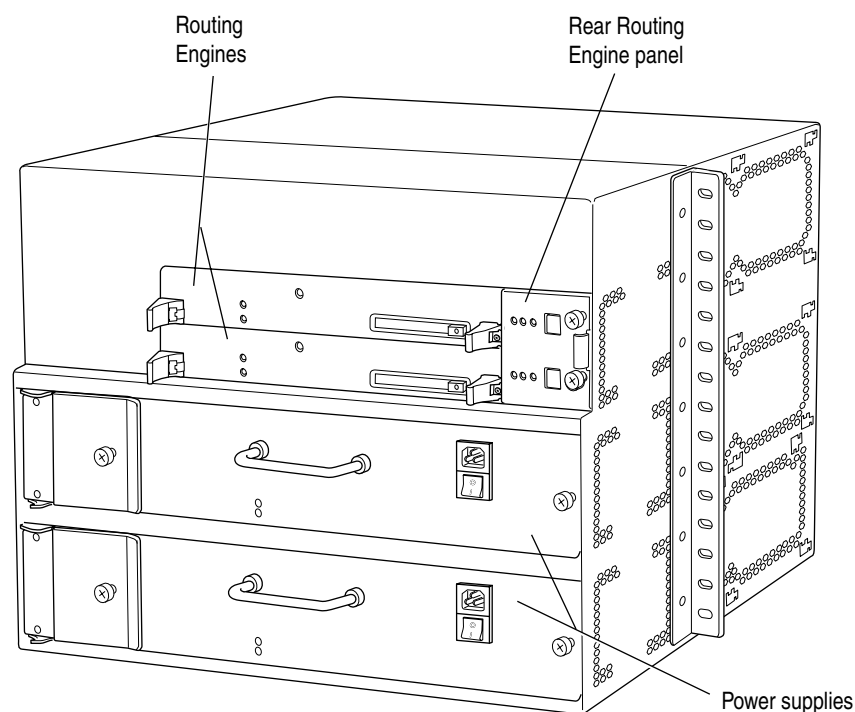
Figure 2: Front View of Chassis

Fan tray
assemblies

SSB0

SSB1

Craft
interface

FPC0

FPC1

FPC2

FPC3

1111

Cable management system
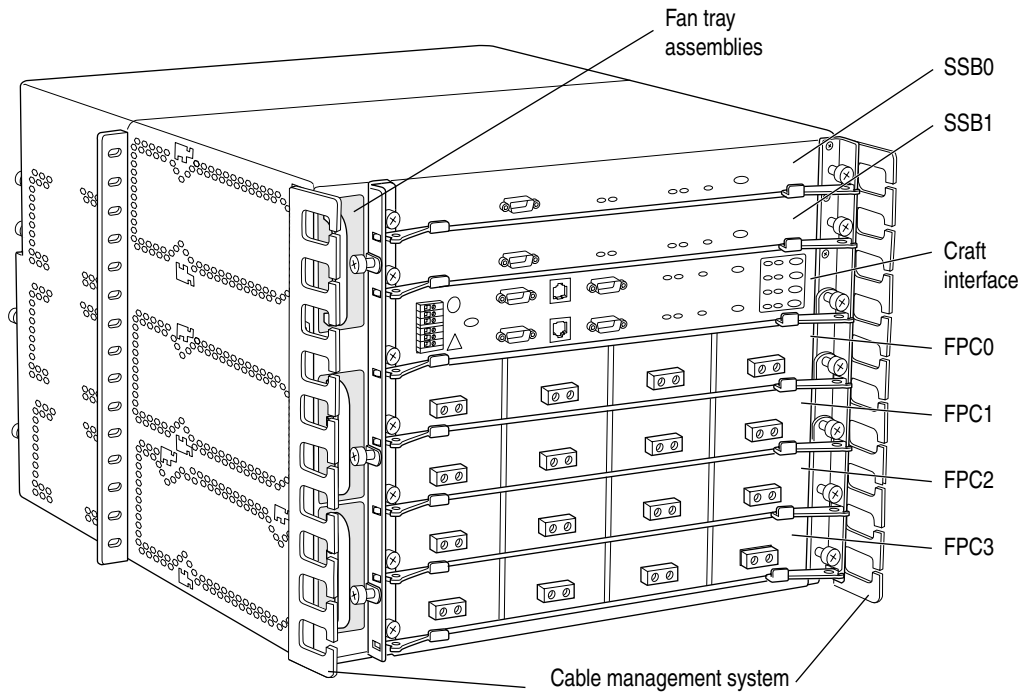
Front-Mounting Brackets

M20 routers have optional brackets you can use to front-mount the router in a rack. The front-mounting brackets are sheet metal with holes in the middle to allow for air flow clearance (see Figure 3). They install on both sides of the router.

Figure 3: M20 Front-Mounting Brackets

Right bracket

Left bracket
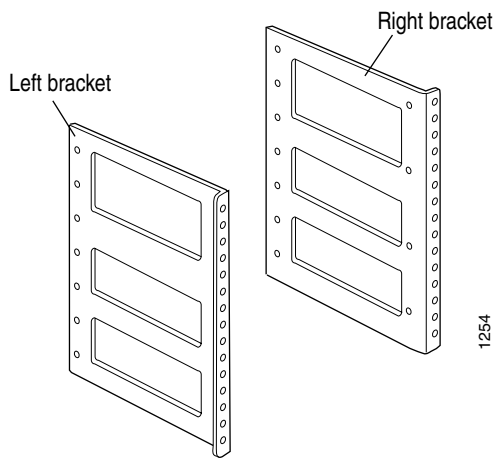
1254

Routing Engine

The Routing Engine consists of an Intel-based PCI platform running JUNOS Internet software (see Figure 4). The Routing Engine module is located in the rear of the router chassis, above the power supplies. It is housed in a metal case that is equipped with thumbscrews to facilitate installation into and removal from the chassis. For redundancy, you can have two Routing Engines in the router (see Figure 4). If one Routing Engine fails, the other one assumes the routing functions.

The Routing Engine is hot-pluggable.

Routing Engine Components

Each Routing Engine (shown in Figure 4) is a two-board system with the following components:

- CPU—Runs JUNOS Internet software to maintain the router's routing tables and routing protocols. It has a Pentium-class processor.

- SDRAM—Provides storage for the routing and forwarding tables and for other Routing Engine processes.

- Compact flash disk—Provides primary storage. It can accommodate two software images, two configuration files, and microcode. This disk is fixed and inaccessible from outside the router.

- Hard disk—Provides secondary storage for log files, memory dumps, and rebooting the system if the flash disk fails.

- PC card slot—Accepts a removable PC card, which stores software images for system upgrades.

- Interfaces for out-of-band management access—Provide information about Routing Engine status to devices (console, laptop, or terminal server) that can be attached to access ports located craft interface on the front of the router.

- EEPROM—Stores the serial number of the Routing Engine.

- LED—Indicates disk activity for the internal IDE interface. It does not necessarily indicate routing-related activity.

  The LEDs that report Routing Engine status are located on the craft interface on the front of the router and are repeated on the Routing Engine panel, which is part of the rear fan tray and is immediately to the right of the Routing Engine (see Figure 5). The Routing Engine LEDs are described in Table 4 on page 19.

- Reset button—Reboots the Routing Engine when pressed.

■ Extractor clips—Control the locking system that secures the Routing Engine in the chassis.

> **Note**
> The appearance and position of electronic components or the PC card slot on your Routing Engine might differ from Figure 4 and other figures in this document. These differences do not affect Routing Engine functionality.

> **Note**
> For specific information about components in your Routing Engine (for example, the capacity of the hard disk), issue the show chassis routing-engine command.

Figure 4: Routing Engine

Extractor clip

Reset button

PC card slot

Extractor clip

1154
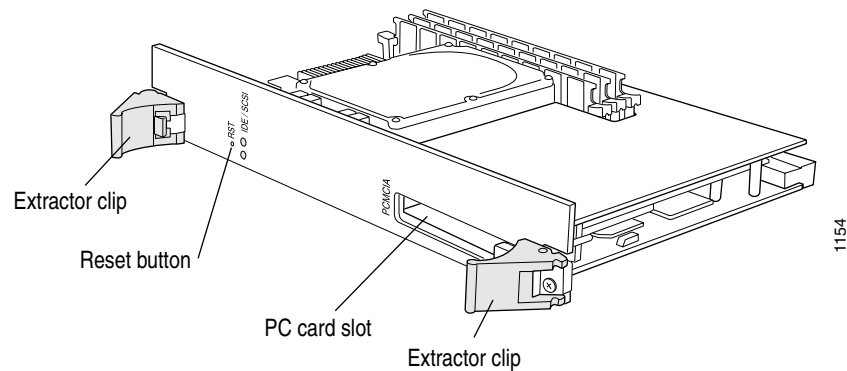
Figure 5: Routing Engine Panel

Routing Engine LEDs

Routing Engine offline switches

1155
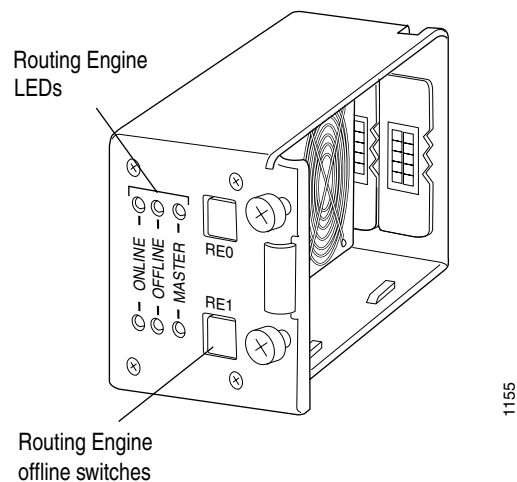
Packet Forwarding Engine

The Packet Forwarding Engine provides Layer 2 and Layer 3 packet switching, route lookups, and packet forwarding. The Packet Forwarding Engine uses application-specific integrated circuits (ASICs) to perform these functions. ASICs include the Distributed Buffer Manager, I/O Manager, Internet Processor, and various media-specific controllers.

The Packet Forwarding Engine occupies the upper center front portion of the chassis and consists of four components:

- Midplane—A single midplane forms the back of the FPC card cage. The System and Switch Board (SSB) and up to four FPCs install horizontally into the midplane from the front of the chassis.

- SSB—The SSB installs horizontally into the midplane.

- FPCs—Up to four FPCs can be installed into the midplane, below the SSB. Each FPC has a set of connectors for attaching one or more PICs.

- PICs—One to four PICs can be attached to each FPC. PICs provide support for various network media, including OC-12 ATM, OC-48 SONET, Gigabit Ethernet, and DS-3.

Midplane

The router midplane forms the back of the card cage (see Figure 6). The FPCs, SSB, and craft interface install into the midplane from the front of the chassis. Fan trays plug into the midplane from both the front and rear of the chassis. Power supplies and the Routing Engine plug into the midplane from the back of the chassis.

The midplane is a component of the Packet Forwarding Engine. It is responsible for power distribution and signal connectivity. The router power supplies are connected to the midplane, which distributes power and provides signal connectivity to all the FPCs, the SSB, and other system components.

Figure 6: The Midplane

Midplane

1115
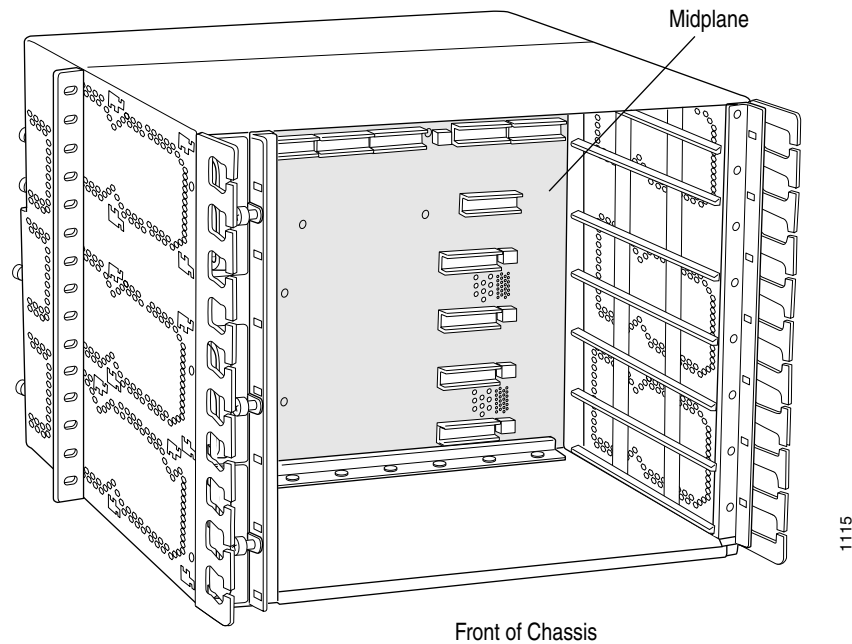
Front of Chassis

System and Switch Board (SSB)

The SSB occupies the top slot of the card cage, installing into the midplane from the front of the chassis. The SSB houses the Internet Processor II ASIC and two Distributed Buffer Manager ASICs. The SSB communicates with the Routing Engine using a dedicated 100-Mbps Fast Ethernet link that transfers routing table data from the Routing Engine to the forwarding table in the Internet Processor II ASIC. The link is also used to transfer from the SSB to the Routing Engine routing link-state updates and other packets destined for the router that have been received through the router interfaces.

The SSB is a component of the Packet Forwarding Engine and performs the following major functions:

- Management of shared memory on the FPCs—The Distributed Buffer Manager ASIC on the SSB uniformly allocates incoming data packets throughout shared memory on the FPCs.

- Transfer of outgoing data cells to the FPCs—A second Distributed Buffer Manager ASIC on the SSB passes data cells to the FPCs for packet reassembly when the data is ready to be transmitted.

- Route lookups—The Internet Processor II ASIC on the SSB performs route lookups using the forwarding table stored in the synchronous SRAM (SSRAM). After performing the lookup, the Internet Processor II ASIC informs the midplane of the forwarding decision, and the midplane forwards the decision on to the appropriate outgoing interface.

■ Monitoring system components—The SSB monitors other system components for failure and alarm conditions. It collects statistics from all sensors in the system and relays them to the Routing Engine, which sets the appropriate alarm. For example, if a temperature sensor exceeds the first internally defined threshold, the Routing Engine issues a "high temp" alarm. If the sensor exceeds the second threshold, the Routing Engine initiates a system shutdown.

■ Transferring exception and control packets—The Internet Processor II ASIC passes exception packets to a microprocessor on the SSB, which processes almost all of them. The remainder are sent to the Routing Engine for further processing. Any errors originating in the Packet Forwarding Engine and detected by the SSB are sent to the Routing Engine using syslog messages.

■ Controlling FPC resets—The SSB monitors the operation of the FPCs. If it detects errors in an FPC, the SSB attempts to reset the FPC. After three unsuccessful resets, the SSB takes the FPC offline and informs the Routing Engine. Other FPCs are unaffected, and normal system operation continues.

The SSB is hot-insertable and hot-removable. You can remove and replace the SSB without powering down the router, but doing so interrupts packet fowarding. Figure 7 shows the SSB board.

Figure 7: System and Switch Board
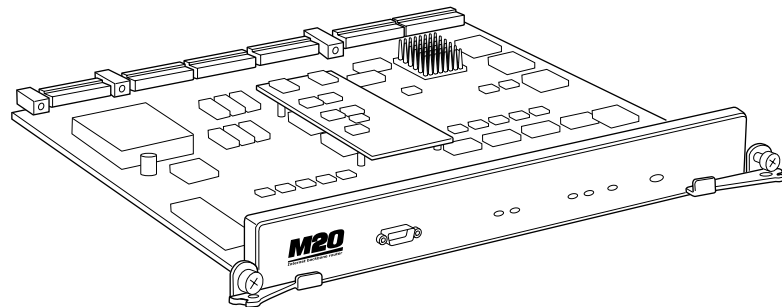
SSB Components

The SSB contains the following components:

■ Processing components

    ■ 200-MHz CPU and supporting logic

    ■ Internet Processor II ASIC

    ■ Distributed Buffer Manager ASICs

    ■ 33-MHz PCI bus—Connects system ASICs

- Storage components

    - Four slots of 2-MB RAM for forwarding tables associated with ASICs

    - 64-MB DRAM for the microkernel

    - EEPROM containing the SSB's serial number and board release version

    - 512-KB boot flash EPROM (programmable on the board)

- System interfaces

    - Three LEDs

    - 100-Mbps Fast Ethernet link for internal interface to the Routing Engine and FPC boards

    - RS-232 debugging port (DB-25 connector)

    - 19.44-MHz reference clock (stratum 3) for SONET PICs

    - I2C controller to read the I2C/EEPROMs in memory, the FPCs, the midplane, and the power supplies

SSB LEDs

The SSB has two groups of LEDs, online/offline LEDs and status LEDs (see Figure 8). The online/offline LEDs indicate whether the SSB is online or offline. The status LEDs indicate what type of task the SSB is performing.

Figure 8: SSB LEDs

Debug port   SSB status LEDs   SSB LEDs   SSB offline switch
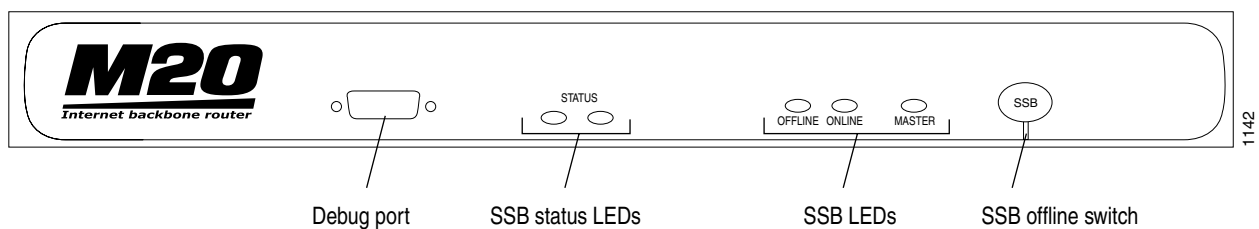
Flexible PIC Concentrators (FPCs)

FPCs are the boards that hold the various media-specific PICs used in the router. Up to four PICs can be installed on each FPC. FPCs install horizontally into the midplane from the front of the chassis below the SSB (see Figure 9). Any FPC can be installed into any FPC slot. The FPCs are numbered 0 through 3, and the FPC slots are labeled from top to bottom—FPC0, FPC1, FPC2, and FPC3.

> **Note**
> If a slot is not occupied by an FPC, a blank FPC carrier must be installed to shield the empty slot so that cooling air can circulate properly throughout the FPC card cage.

The FPCs connect the PICs to the rest of the router so that incoming packets can be forwarded across the midplane to the appropriate destination port. FPCs contain shared memory, which is managed by the Distributed Buffer Manager ASIC on the SSB, for storing data packets received by the PICs. The I/O Manager ASIC on each FPC breaks incoming data packets from the PICs into 64-byte memory blocks, which are stored in a shared memory buffer. It then reassembles them into data packets when they are ready for transmission.

FPCs are hot-insertable and hot-removable. When you remove an FPC and install a new one, the midplane flushes the entire system memory pool before the new card is brought online, a process that takes about 200 ms.

When you install an FPC into a running system, the Routing Engine downloads the FPC software, the FPC runs its diagnostics, and the PICs on the FPC slot are enabled. No interruption occurs to the routing functions.

Figure 9: FPCs with PICs in the Chassis
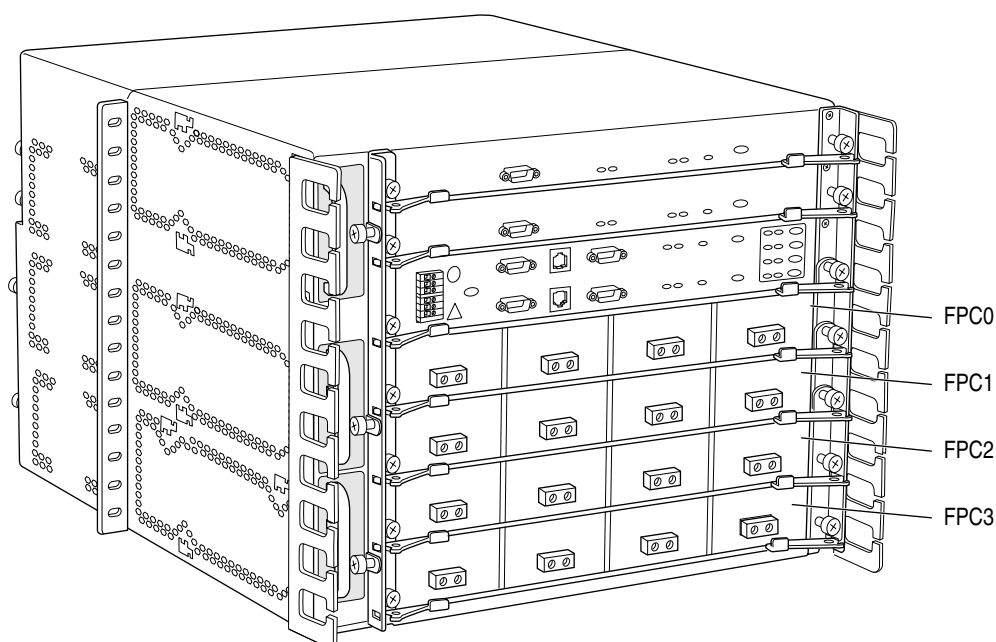
1111-B

FPC Components

Each FPC contains the following components:

- FPC board carrier that has a PowerPC 603e processor and an I/O Manager ASIC

- Two identical 64-MB SDRAM DIMMs—Used as shared memory by the Distributed Buffer Manager ASIC on the SSB

- 1-MB SSRAM module

- 8-MB DRAM—Used by the PowerPC 603e processor

- EEPROM—Contains the FPC's serial number and board release version

- Two status LEDs—The LEDs are located on the craft interface (see Table 5 on page 20)

Physical Interface Cards (PICs)

The M20 router supports various PICs, including ATM, Channelized OC-12, DS-3, Fast Ethernet, Gigabit Ethernet, SONET/SDH, and Tunnel PICs. For more information, see the *M20 Internet Router PIC Guide*.

Craft Interface

The craft interface allows you to view normal status and troubleshooting information at a glance and to perform many system control functions. The craft interface is located below the SSB on the front of the chassis and contains the following elements (see Figure 10) described in this section:

- Alarm Relay Contacts, Alarm LEDs, and Alarm Cutoff Button on page 18

- Routing Engine Ports on page 19

- Link and Activity Status Lights on page 19

- Routing Engine LEDs on page 19

- Routing Engine Offline Buttons on page 19

- FPC LEDs on page 20

- FPC Offline Buttons on page 20

The power supply LEDs are located on the power supply faceplates, at the bottom rear of the chassis, not on the craft interface.

Figure 10: Craft Interface
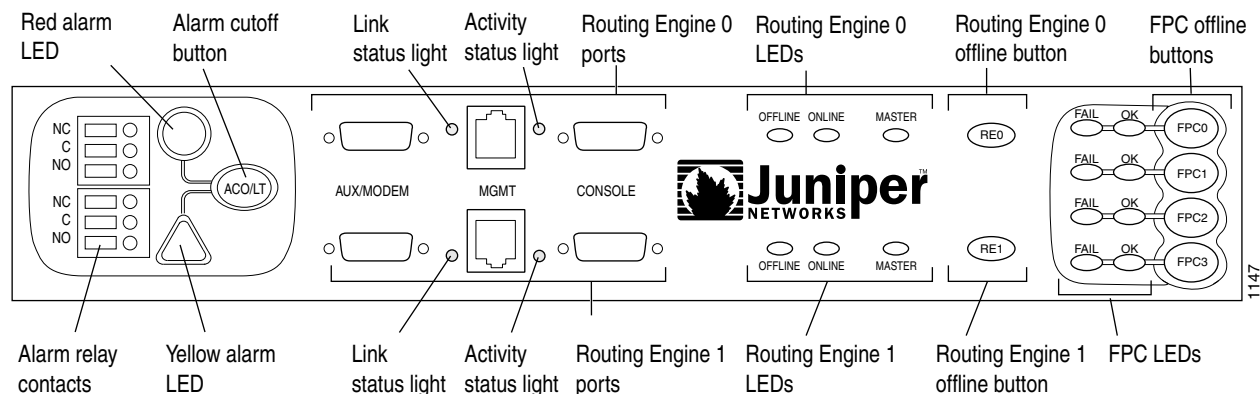
Alarm Relay Contacts, Alarm LEDs, and Alarm Cutoff Button

The craft interface contains two sets of alarm relay contacts, which are on the left side of the craft interface. The upper set is activated by a system red alarm and the lower set by a system yellow alarm.

Immediately to the right of the alarm relay contacts are the red and yellow alarm LEDs. These LEDs light when a red or yellow alarm condition occurs.

To the right of the LEDs is the alarm cutoff/lamp test (ACO/LT) button. Press this button to deactivate the red or yellow alarm LED. Note that deactivating the LED and alarm does not correct the problem. You also use the ACO/LT button to test all the LEDs on the craft interface.

Table 3 explains the alarm LEDs and buttons.

Table 3: Alarm LEDs and Buttons

Label	Shape	Color	State	Description
Alarm LEDs (Both alarms can occur simultaneously.)				
None (red LED)		Red	On steadily	System failure or power supply failure. The system shut down because of hardware malfunction or some threshold being exceeded.
None (yellow LED)		Amber	On steadily	System warning such as maintenance alert or significant temperature increase.
ACO/LT		Blue/Green Button	Button	Cut off an alarm. Test the LEDs on the craft interface.

Routing Engine Ports

The Routing Engine has three ports for connecting external management devices (see Figure 10). You can use the command-line interface (CLI) on these management devices to configure the router. The following ports are located near the middle of the craft interface, one set for each Routing Engine:

- Console port—Used to connect a system console to the Routing Engine with an RS-232 serial cable.

- Auxiliary port—Used to connect a laptop or modem to the Routing Engine with an RS-232 serial cable.

- Ethernet management port—Used to connect the Routing Engine to a management LAN (or any other device that plugs into an Ethernet connection) for out-of-band management of the router system. The Ethernet port can be 10 or 100 Mbps and uses an autosensing RJ-45 connector.

Link and Activity Status Lights

The link status lights are located to the left of the Ethernet management ports on the craft interface, and the activity status lights are located to the right of the Ethernet management ports on the craft interface (see Figure 10). The link and activity status lights report the status of the external management connections. The link light indicates whether the link has been established and the status light indicates data is being transferred.

Routing Engine LEDs

The Routing Engine LEDs on the craft interface report the status of the Routing Engine. They are located above and below the Juniper Networks logo near the middle of the craft interface (see Figure 10). Table 4 describes the Routing Engine LEDs.

Table 4: Routing Engine LEDs and Buttons

Label	Color	State	Description
MASTER	Blue	On steadily	Master.
ONLINE	Green	On steadily	Routing Engine has successfully booted and is running normally.
OFFLINE	Amber	On steadily	Routing Engine is not operational, or is in reset mode.
RE0, RE1	—	—	Press to take the Routing Engine offline.

Routing Engine Offline Buttons

Routing Engine offline buttons are used to take the Routing Engine offline if it needs to be replaced. The offline buttons are located to the right of the Routing Engine LEDs (see Figure 10). They are explained in Table 4.

The Routing Engine LEDs are repeated on the Routing Engine panel, which is located to the right of the Routing Engine on the back of the chassis (see Figure 5 on page 11).

FPC LEDs

The FPC LEDs on the craft interface report the status of each FPC. They are located on the right side the craft interface (see Figure 10). Table 5 describes the FPC LEDs.

Table 5: FPC LEDs and Buttons

Label	Shape	Color	State	Description
OK	⬭	Green	On steadily	FPC is functioning normally.
			Blinking	FPC is starting up.
FAIL	⬭	Amber	On steadily	FPC has failed.
FPC0, FPC1, FPC2, FPC3	⬭	—	—	Press to take an FPC offline.

FPC Offline Buttons

FPC offline buttons are used to take the FPC offline if it needs to be replaced. The offline buttons are located on the right side of the craft interface (see Figure 10). They are explained in Table 5.

Power Supplies

The power supplies install at the lower rear of the chassis, in the power supply bays (see Figure 1 on page 8). The power supplies are internally connected to the midplane, which distributes the different output voltages produced by the power supplies throughout the system and its components.

The router has two fully redundant power supplies that load-share during normal operation. A single power supply can provide full power (up to 750 W) for as long as the system is operational. Redundancy is necessary only in case of power supply failure.

Each power supply has an internal fan and is self-cooled.

Power supplies are field-replaceable. They are hot-removable and hot-insertable, but you must turn off the power to the individual supply before removing it from the chassis. When the power is cut off to one power supply or a failure occurs within a power supply, the other power supply immediately and automatically assumes the entire electrical load.

The router supports DC (see Figure 11) and AC (see Figure 12) power supplies. An enable control signal on the output connector ensures that the power supply is fully seated into the router midplane before the power supply can be turned on. The enable pin prevents a user-accessible energy hazard, so there is no interlocking mechanism. The enable pin disables the voltage at the output connector if the power supply is not turned off before removal.

> **Note**
>
> No mixing of DC and AC power supplies is supported. If two power supplies are present in a router chassis, they must either be both DC or both AC.

Each power supply has status LEDs located below the handle near the middle of the supply. The power supply LEDs are described in Table 6.

Figure 11: DC Power Supply

Figure 12: AC Power Supply

Power cord and
On/off switch

1140b
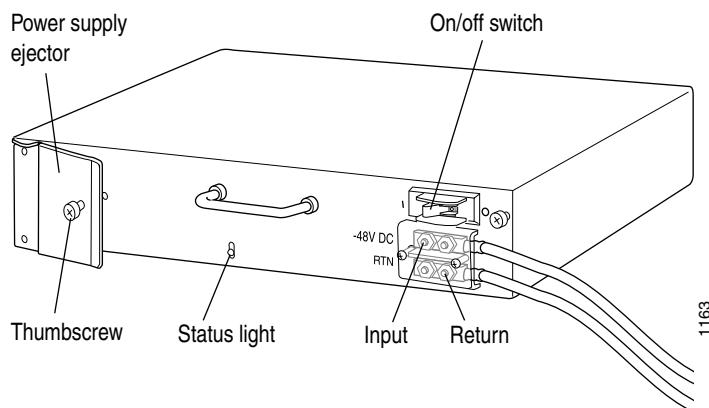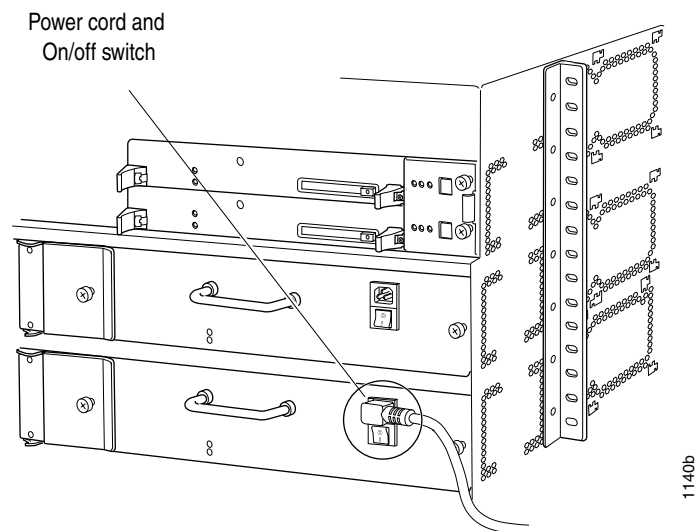
Table 6: Power Supply LEDs

Label	Color	State	Description
OK	Green	On steadily	Power supply is functioning normally, input is occurring, outputs are within range, temperature is within range, and fans are operational.
FAIL	Amber	On steadily	Power supply has failed.

Power Supply Electrical Specifications

Table 7 lists the DC power supply electrical specifications, and Table 8 lists the AC power supply electrical specifications.

> **Note**
> One Routing Engine must be present in the router chassis to power on a DC or an AC power supply. If the minimum load is not present, the power supply might shut down and you will have to cycle the power on/off switch.

Table 7: DC Power Supply Electrical Specifications

Description	Specification
Power supply	750 W maximum output
DC input voltage	–40 through –72 VDC operating range
Input DC current rating	24A @ –48 VDC (typical)
Output voltage	+ 3.3 V, + 2.53 V, + 5.05 V, + 5 V, + 24 V, + 12 V

> **Note**
> The DC power supplies are marked –48 VDC. This is the nominal voltage associated with the battery circuit. Any higher voltages are to be associated only with float voltages for the charging function.

Table 8: AC Power Supply Electrical Specifications

Description	Specification
Power supply	750 W maximum
Input voltage	90–264 V operating range
Input line frequency	47–63 Hz, autoranging
Input current rating	13A @ 90V
Output voltage	+ 3.3 V, + 2.5 V, + 5.05 V, + 5 V, + 24 V, + 12 V

Power Supply Cables

The DC power supply uses a cable lug and locking washers to attach the cables to the supply (see Figure 13).

AC power supply cords are country-specific. The AC inlet is oriented to allow a standard right-angle power cord to exit to the right of the power supply. A power cord latching mechanism is provided for the use of straight power cords (see Figure 14).

Figure 13: DC Power Supply Cables
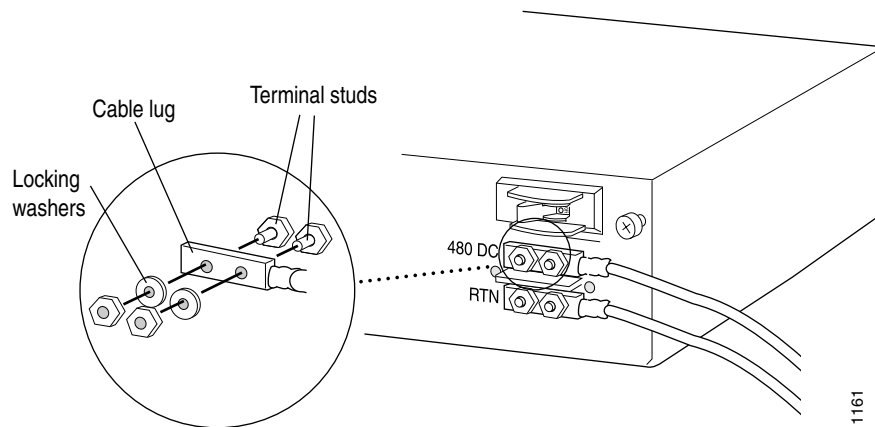
Figure 14: AC Power Supply Cables
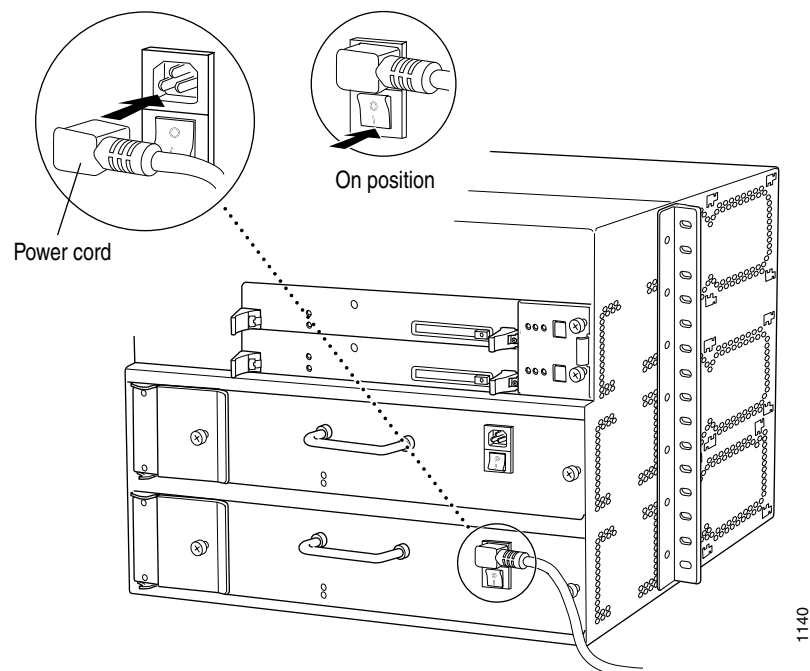
Cooling System

The router cooling system consists of the following components:

- Three front fan trays—Cool the FPCs and the SSB. These fan trays are located on the left front side of the chassis.

- One rear fan tray—Cools the Routing Engine. This fan tray is located immediately to the right of the Routing Engine

- Power supply integrated fan—A built-in fan cools each power supply.

The four fan trays work together to provide side to side cooling (see Figure 15).

The fan trays plug directly into the router midplane.

Each front fan tray is a single field-replaceable unit that contains three fans. The rear fan tray is a field-replaceable unit that contains two fans. Both front and rear fan trays are hot-swappable.

> **Note**
>
> The router should not be operated for more than 1 minute without a fan tray.

Figure 15: Air Flow through the Chassis
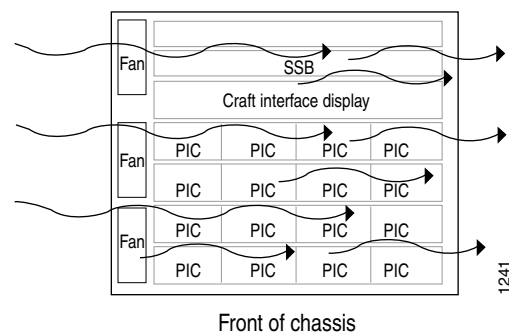
Front of chassis

Cable Management System

The cable management system consists of two vertical pieces that attach to each side of the front of the chassis (see Figure 2 on page 9). Each piece consists of a row of staggered metal hooks, each draped with a rounded plastic shield. The router cable management system is designed to maintain the proper bend radius for optical cables and to keep installed cables organized and securely in place. The cable management system evenly distributes the weight of the optical cables so that no individual cable is subjected to undue stress. It also eases cable installation by providing a place to store the cable and by keeping it from getting tangled.

> Using the cable management system on the left side of the chassis creates a blockage when removing or replacing the front fan trays.
>
> **Note**

Chapter 3
JUNOS Internet Software Overview

The JUNOS Internet software provides Internet Protocol routing software—as well as software for interface, network, and chassis management—especially designed for the large production networks typically supported by Internet Service Providers (ISPs).

The JUNOS Internet software runs on the router's Routing Engine. The software consists of processes that provide support for Internet routing protocols, control of the router's interfaces and of the router chassis itself, and allow system management of the router. All these processes run on top of a kernel that provides the communication among all the processes and has a direct link to the Packet Forwarding Engine software.

You use the JUNOS Internet software to configure the routing protocols that should run on the router and the properties of the interfaces in the router. After you have activated a software configuration, you use the JUNOS Internet software to monitor the protocol traffic passing through the router and to troubleshoot protocol and network connectivity problems.

This chapter discusses the following topics to provide an overview of the components of the JUNOS Internet software and of how to use the software:

- Routing Engine Software Components on page 27

- Tools for Accessing and Controlling the Software on page 31

- Software Monitoring Tools on page 32

- Software Installation and Upgrade Procedures on page 32

For complete information about configuring and using the software, including examples, see the JUNOS Internet software configuration guides and the *JUNOS Internet Software Operational Mode Command Reference*.

Routing Engine Software Components

The Routing Engine software consists of several software processes that control router functionality and a kernel that provides the communication among all the processes. This section describes each of the Routing Engine software components:

- Routing Protocol Process on page 28

- Interface Process on page 31

- SNMP and MIB II Processes on page 31

- Management Process on page 31

- Routing Engine Kernel on page 31

Routing Protocol Process

The JUNOS software routing protocol process controls the routing protocols that run on the router. The routing protocol process starts all configured routing protocols and handles all routing messages. It maintains one or more routing tables, which consolidate the routing information learned from all routing protocols into common tables. From this routing information, the routing protocol process determines the active routes to network destinations and installs these routes into the Routing Engine's forwarding table.

Finally, the routing protocol process implements routing policy, which allows you to control the routing information that is transferred between the routing protocols and the routing table. Using routing policy, you can filter routing information so that only some of it is transferred, and you also can set properties associated with the routes.

For complete information about the routing protocol process, including routing protocols, routing and forwarding tables, routing policy, and interfaces, see the JUNOS Internet software configuration guides.

Routing Protocols

The JUNOS Internet software implements full IP routing functionality, providing support for IP Version 4 (IPv4) and IP Version 6 (IPv6). The routing protocols are fully interoperable with existing IP routing protocols, and provide the scale and control necessary for the Internet core. The software provides support for the following routing and traffic engineering protocols:

- Unicast routing protocols

  - IS-IS—Intermediate System-to-Intermediate System is an interior gateway protocol (IGP) for IP networks that uses the shortest-path-first (SPF) algorithm, which also is referred to as the Dijkstra algorithm, to determine routes.

  - OSPF—Open Shortest Path First, Version 2, is an IGP that was developed for IP networks by the Internet Engineering Task Force (IETF). OSPF is a link-state protocol that makes routing decisions based on the SPF algorithm.

  - RIP—Routing Information Protocol, Version 2, is an IGP for IP networks based on the Bellman-Ford algorithm. RIP is a distance-vector protocol. The JUNOS RIP software is compatible with RIP Version 1.

  - BGP—Border Gateway Protocol, Version 4, is an Exterior Gateway Protocol (EGP) that guarantees loop-free exchange of routing information between routing domains (also called autonomous systems). BGP, in conjunction with JUNOS routing policy, provides a system of administrative checks and balances used to implement peering and transit agreements.

  - ICMP—Internet Control Message Protocol router discovery allows hosts to discover the addresses of operational routers on the subnet.

- Multicast routing protocols

    - DVMRP—Distance Vector Multicast Routing Protocol is a dense-mode (flood-and-prune) multicast routing protocol.

    - PIM sparse mode and dense mode—Protocol-Independent Multicast is a multicast routing protocol. PIM sparse mode routes to multicast groups that might span wide-area and interdomain internetworks. PIM dense mode is a flood-and-prune protocol.

    - IGMP—Internet Group Management Protocol, Versions 1 and 2, is used to manage membership in multicast groups.

    - SAP/SDP—Session Announcement Protocol and Session Description Protocol handle conference session announcements.

    - MSDP—Multicast Source Discovery Protocol allows multiple PIM sparse mode domains to be joined. A rendezvous point (RP) in a PIM sparse mode domain has a peering relationship with an RP in another domain, thereby discovering multicast sources from other domains.

- Traffic engineering protocols

    - MPLS—Multiprotocol Label Switching allows you to manually or dynamically configure label-switched paths through a network, thus providing a means for engineering how traffic traverses the network by directing it through particular paths rather than relying on the IGP's least-cost algorithm to choose a path.

    - RSVP—Resource Reservation Protocol, Version 1, provides a mechanism for engineering network traffic patterns that is independent of shortest path decided upon by a routing protocol. RSVP itself is not a routing protocol, but is designed to operate with current and future unicast and multicast routing protocols. JUNOS RSVP software primarily supports dynamic signaling for MPLS paths.

Routing and Forwarding Tables

A major function of the JUNOS routing protocol process is to maintain the Routing Engine's routing tables and from these tables, to determine the active routes to network destinations. It then installs these routes into the Routing Engine's forwarding table. The JUNOS kernel then copies this forwarding table to the Packet Forwarding Engine.

More specifically, the routing protocol process maintains multiple routing tables. By default, it maintains three routing tables, and you can configure additional routing tables to suit your requirements.

- Unicast routing table—Stores routing information for all unicast routing protocols running on the router. IS-IS, OSPF, and BGP all store their routing information in this common routing table, and you can configure additional routes, such as static routes, to be included in this routing table. IS-IS, OSPF, and BGP use the routes in the unicast routing table when advertising routing information to their neighbors.

- Multicast routing table (cache)—Stores routing information for all the running multicast protocols. DVMRP and PIM both store their routing information in this common routing table, and you can configure additional routes to be included in this routing table.

- MPLS routing table—Stores MPLS label information.

With each routing table, the routing protocol process uses the collected routing information to determine active routes to network destinations. For unicast routes, the routing protocol process determines active routes by choosing the most-preferred route, which is the route with the lowest preference value. By default, the route's preference value is simply a function of how the routing protocol process learned about the route. You can modify the default preference value using routing policy and with software configuration parameters.

For multicast traffic, the routing protocol process determines active routes based on traffic flow and other parameters specified by the multicast routing protocol algorithms. The routing protocol process then installs one or more active routes to each network destination into the Routing Engine forwarding table.

Routing Policy

By default, all routing protocols place their routes into the routing table. When advertising routes, the routing protocols, by default, advertise only a limited set of routes from the routing table. Specifically, each routing protocol exports only the active routes that were learned by that protocol. In addition, IGPs (IS-IS, OSPF, and RIP) export the direct (interface) routes for the interfaces on which the protocol is explicitly configured.

For each routing table, you can affect the routes that a protocol places into the table and the routes from the table that the protocol advertises by defining one or more routing policies and then applying them to the specific routing protocol.

Routing policies applied when the routing protocol places routes into the routing table are referred to as import policies because the routes are being imported into the routing table. Policies applied when the routing protocol is advertising routes that are in the routing table are referred to as export policies because the routes are being exported from the routing table.

Routing policy allows you to control (filter) which routes are imported into the routing table and which routes are exported from the routing table. Routing policy also allows you to set the information associated with a route as it is being imported into or exported from the routing table. Applying routing policy to imported routes allows you to control the routes used to determine active routes. Applying routing policy to routes being exported from the routing table allows you to control the routes that a protocol advertises to its neighbors.

You implement routing policy by defining policies. A policy specifies the conditions to use to match a route and the action to perform on the route when a match occurs. For example, when a routing table imports routing information from a routing protocol, a routing policy might modify the route's preference, mark the route with a color to identify it and allow it to be manipulated at a later time, or prevent the route from even being installed in a routing table. When exporting routes from a routing table into a routing protocol, a policy might assign metric values, modify the BGP community information, tag the route with additional information, or prevent the route from being exported altogether. You also can define policies for redistributing the routes learned from one protocol into another protocol.

Interface Process

The JUNOS interface process, dcd, allows you to configure and control the physical interface devices and logical interfaces in the router. You configure various interface properties such as the interface location (slot in which the FPC is installed and the location on the FPC in which the PIC is installed), the interface type (such as SONET or ATM), encapsulation, and interface-specific properties. You can configure the interfaces that are currently present in the router, as well as interfaces that you might be adding.

The JUNOS interface process communicates through the JUNOS kernel with the interface process in the Packet Forwarding Engine, thus enabling the JUNOS Internet software to track the status and condition of the router's interfaces.

SNMP and MIB II Processes

The JUNOS Internet software supports the Simple Network Management Protocol (SNMP), Versions 1 and 2, which provides a mechanism for monitoring the state of the router. This software is controlled by the JUNOS SNMP and MIB II processes, which consist of an SNMP master agent and a MIB II agent.

Management Process

Within the JUNOS Internet software, a management process starts and monitors all the other software processes, as well as the CLI, which is the primary tool you use to control and monitor the JUNOS Internet software. The management process starts all the software processes and the CLI when the router boots. If a software process terminates for some reason, the management process makes all reasonable attempts to restart it.

Routing Engine Kernel

The Routing Engine kernel provides the underlying infrastructure for all the JUNOS software processes. In addition, it provides the link between the routing protocol process' routing tables and the Routing Engine's forwarding table, and it communicates with the Packet Forwarding Engine, including keeping the Packet Forwarding Engine's copy of the forwarding table synchronized with the master copy in the Routing Engine.

Tools for Accessing and Controlling the Software

The CLI is the interface to the JUNOS Internet software that you use whenever you access the router from the console or through a remote network connection. The CLI provides commands that you use to perform various tasks, including configuring the JUNOS Internet software and monitoring and troubleshooting the software, network connectivity, and the router hardware.

The JUNOS CLI is a straightforward command interface. You type commands on a single line, and the commands are executed when you press the **Enter** key. The CLI provides command help and command completion, and it also provides Emacs-style keyboard sequences that allow you to move around on a command line and scroll through a buffer that contains recently executed commands.

The router provides three ports on the craft interface for connecting external management devices to the Routing Engine and hence to the JUNOS Internet software. See "Routing Engine Ports" on page 19 of the Hardware Component Overview chapter.

Software Monitoring Tools

You monitor and troubleshoot the software, routing protocols, network connectivity, and the router hardware by entering commands from the CLI. The CLI provides commands that let you display information in the routing tables, display routing protocol–specific information, and check network connectivity using the **ping** and **traceroute** commands.

The JUNOS Internet software includes Simple Network Management Protocol (SNMP) software, which allows you to manage routers. The SNMP software consists of an SNMP master agent and a MIB II agent, and provides full support for MIB II SNMP Version 1 traps and Version 2 notifications, and SNMP Version 1 **Get**, **GetNext**, and **Set** requests, and Version 2 **GetBulk** requests.

The software also supports tracing and logging operations, which allow you to track events that occur in the router—both normal router operations and error conditions—and to track the packets that are generated by or pass through the router. Logging operations use a syslog-like mechanism to record system-wide, high-level operations, such as interfaces going up or down and users logging into or out of the router. Tracing operations record more detailed messages about the operation of routing protocols, such as the various types of routing protocol packets sent and received, and routing policy actions.

Software Installation and Upgrade Procedures

The JUNOS software is preinstalled in the router. To upgrade the software, you copy a set of software images over the network to the router's flash disk using the CLI. The JUNOS Internet software set consists of several images that are provided in individual packages or as a single bundle. You normally upgrade all packages simultaneously. For information on installing and upgrading JUNOS software, see the JUNOS Internet software configuration guides.

Chapter 4
System Architecture Overview

This chapter provides an overview of the M20 Internet Router's system architecture, discussing the following topics:

- Packet Forwarding Engine on page 33—This high-performance, ASIC-based component provides Layer 2 and Layer 3 packet switching, route lookups, and packet forwarding.

- Routing Engine on page 35—This component provides Layer 3 routing services and network management.

The Packet Forwarding Engine and Routing Engine perform their primary tasks independently, although they constantly communicate through a 100-Mbps internal link. This arrangement streamlines forwarding and routing control and runs Internet-scale backbone networks at high speeds.

Figure 16: Router Architecture
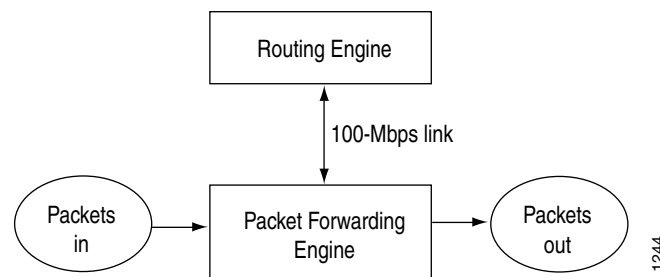
Packet Forwarding Engine

The router's Packet Forwarding Engine provides Layer 2 and Layer 3 packet switching. The Packet Forwarding Engine can forward up to 40 million packets per second for all packet sizes. The maximum aggregate throughput rate for the router is 12 Gbps (full duplex) or 3 Gbps per FPC installed in the system. The Packet Forwarding Engine is implemented in ASICs and consists of a shared memory design with a centralized route lookup engine.

The Packet Forwarding Engine has the following hardware components (see Figure 17):

- Midplane—Performs power distribution and signal connectivity.

- SSB—Hosts the Internet Processor ASIC, which makes forwarding decisions, and the Distributed Buffer Manager ASIC, which allocates incoming data packets evenly throughout shared memory in the FPCs.

- FPCs—Provide shared memory and connect the PICs to the rest of the router so that packets can be routed to the appropriate destination port. Each FPC hosts an I/O Manager ASIC that breaks incoming data packets into 64-byte memory blocks and reassembles memory blocks into data packets when they are ready for transmission.

- Physical interface cards (PICs)—Each PIC hosts a controller ASIC that performs control functions tailored to the PIC's media type. PICs provide a complete range of fiber-optic and digital transmission interfaces to the network.

Figure 17: Packet Forwarding Engine Components and Data Flow
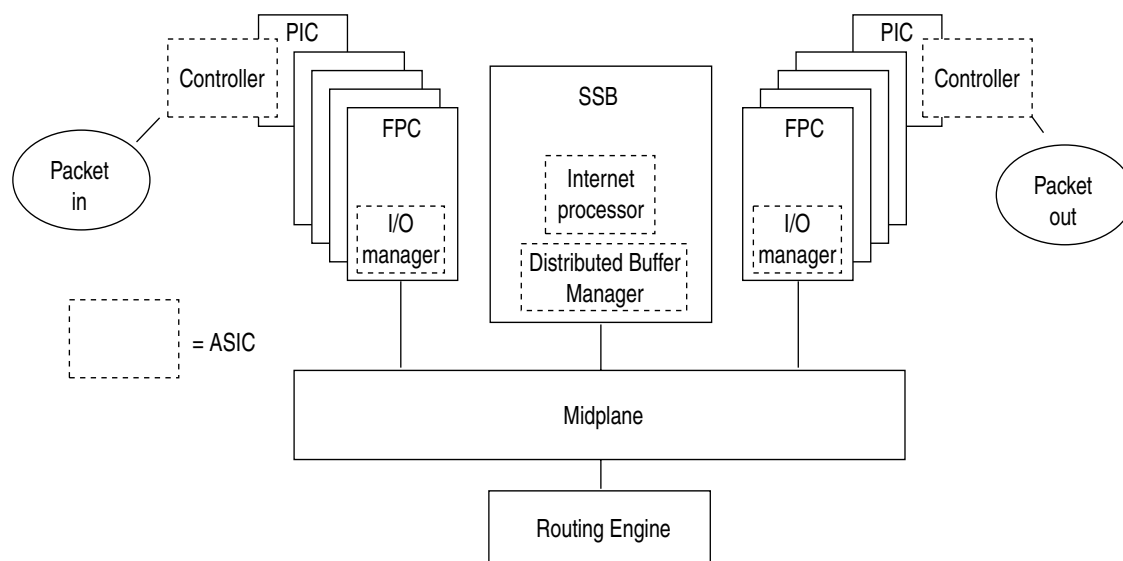
Data Flow through the Packet Forwarding Engine

To ensure efficient data packet movement through the system, the router is designed so that ASICs on the hardware components handle the forwarding of data packets. Data flows through the Packet Forwarding Engine in the following sequence (see Figure 17):

1. Packets arrive at an incoming PIC interface.

2. The PIC passes the packets to the FPC, where the I/O Manager ASIC breaks them into 64-byte cells.

3. The Distributed Buffer Manager ASIC on the SSB distributes the data cells throughout memory banks that are shared over all the FPCs.

4.   The Internet Processor ASIC on the SSB performs route lookups and makes forwarding decisions.

5.   The Internet Processor ASIC notifies a second Distributed Buffer Manager ASIC on the SSB, which forwards the notification to the outgoing interface.

6.   The I/O Manager ASIC on the FPC reassembles data cells in shared memory into data packets as they are ready for transmission and passes them to the outgoing PIC.

7.   The outgoing PIC transmits the data packets.

Routing Engine

The Routing Engine consists of JUNOS Internet software running on an Intel-based PCI platform. The JUNOS Internet software was developed and optimized by Juniper Networks to scale to large numbers of network interfaces and routes. The software consists of a series of system processes running in protected memory modules on top of an independent operating system. The JUNOS kernel supports JUNOS system processes which handle system management processes, routing protocols, and control functions (see Figure 18).

The Routing Engine has a dedicated 100-Mbps internal connection to the Packet Forwarding Engine.

Figure 18: Routing Engine Architecture
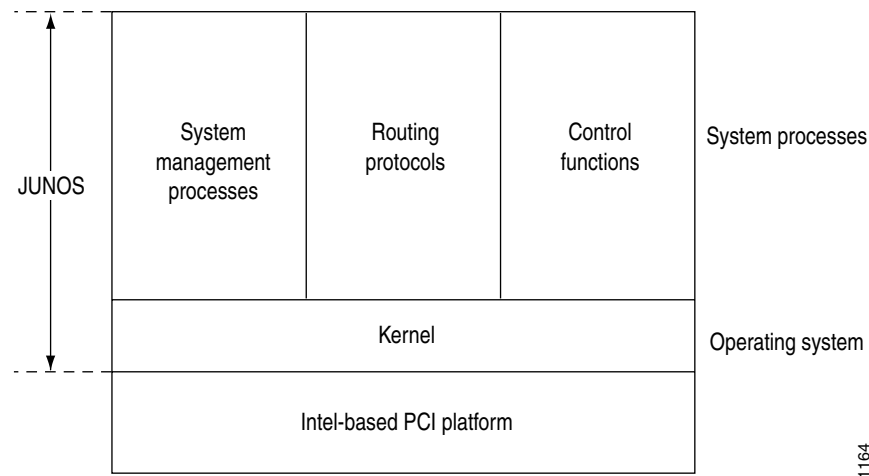
Routing Engine Functions

The Routing Engine handles all the routing protocol processes, as well as other software processes that control the router's interfaces, some of the chassis components, system management, and user access to the router. These routing and software processes run on top of a kernel that interacts with the Internet processor ASIC in the Packet Forwarding Engine.

The Routing Engine provides the following features:

- Process routing protocol packets—All routing protocol packets from the network are directed to the Routing Engine, and thereby do not delay the Packet Forwarding Engine unnecessarily.

- Software modularity—By dividing the different software functionalities into separate processes, the failure of one process is isolated from others and has little or no effect on the other software processes.

- In-depth Internet functionality—Each routing protocol is implemented with a complete set of Internet features, and provides full flexibility for advertising, filtering, and modifying routes. Routing policies are set according to route parameters (for example, prefix, prefix lengths, and BGP attributes).

- Scalability—The JUNOS routing tables have been designed to hold all the routes in current and near-future networks. Additionally, the JUNOS Internet software can efficiently support large numbers of interfaces and virtual circuits.

- Management interface—Different management interfaces are provided, including a command-line interface, a craft interface, and SNMP.

- Storage and change management—Configuration files, system images, and microcode can be held and maintained in primary and secondary storage systems, permitting local or remote upgrades.

- Monitoring efficiency and flexibility—The router permits alarm handling and packet counting, for example, on every port, without adversely affecting packet forwarding performance.

The Routing Engine constructs and maintains one or more packet forwarding tables (see Figure 19). From the routing tables, the Routing Engine derives a table of active routes, called the forwarding table, which is then copied into the Packet Forwarding Engine. The design of the Internet processor ASIC allows the forwarding table in the Packet Forwarding Engine to be updated without interrupting forwarding.

Figure 19: Control Packet Handling—Routing and Forwarding Table Updates
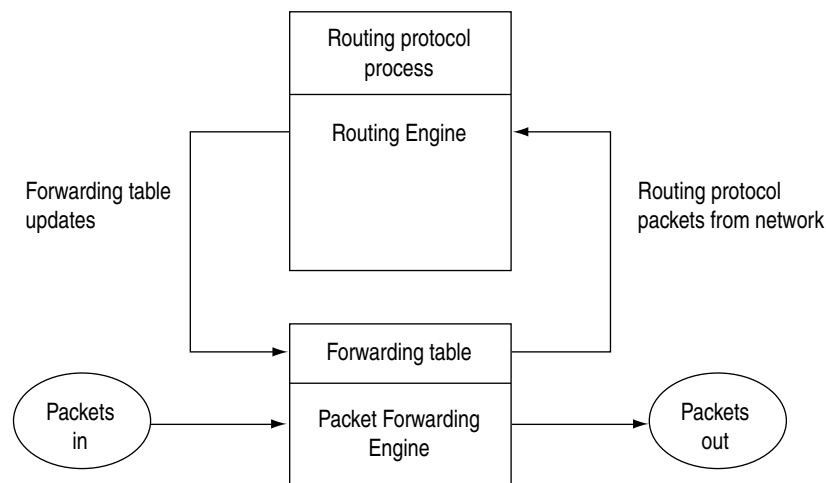
Part 2
Initial Installation

- Prepare the Site on page 39

- Regulatory Compliance and Safety Information on page 57

- Prepare to Install the Router on page 91

- Install the Router and Perform Initial Software Configuration on page 97

Chapter 5
Prepare the Site

This chapter describes how to prepare your site so that you can install a router, discussing the following topics:

- Rack Requirements on page 39

- Clearance Requirements Outside the Rack on page 41

- Site Environmental Requirements on page 43

- Fire Safety on page 43

- Fire Safety on page 43

- AC Power Supplies on page 46

- DC Power Supplies on page 48

- System Grounding Guidelines on page 50

- Network Cable Requirements on page 51

- Site Wiring Guidelines on page 52

- SONET/SDH and ATM Connection Guidelines on page 52

- Site Preparation Checklist on page 56

Rack Requirements

The router must be installed in a rack. It can be mounted in many types of racks, including the following:

- Standard 19-in. (48.26 cm) equipment rack

- Standard telco rack (four-post)

- Center-mount rack

Figure 20 illustrates a typical center-mount rack.

Select a rack that satisfies the following requirements:

- Alignment of rack-mounting holes

- Rack size and strength

- Air flow clearance

Figure 20: Typical Center-Mount Rack
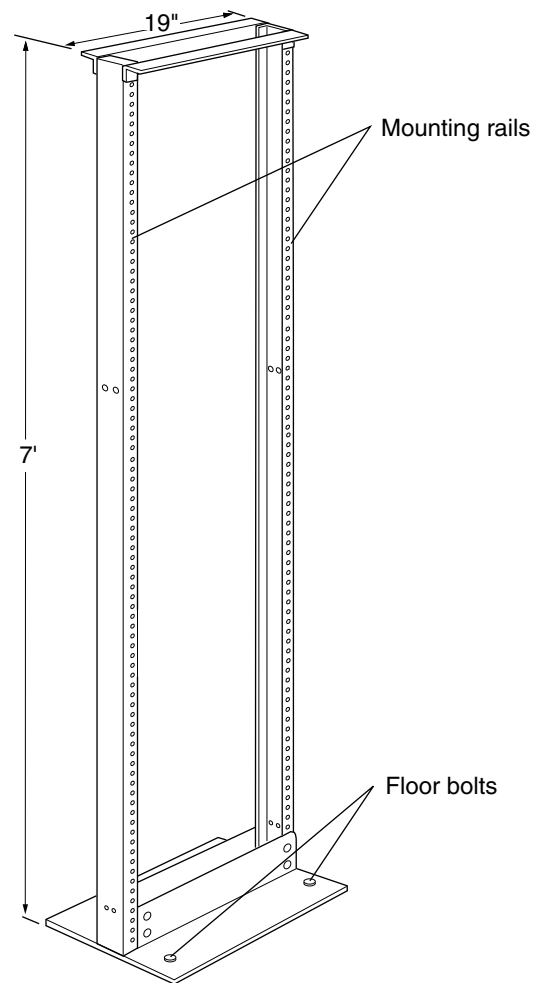
Alignment of Rack-Mounting Holes

The mounting holes on the rack rails must align with the mounting holes on the chassis mounting ears. The chassis is equipped with two different sets of vertical mounting ears, one set intended for center-mount racks and one set intended for front-mount racks. Table 9 lists the spacing between mounting holes on these ears for each type of rack.

Table 9: Chassis Rack-Mounting Hole Spacing

Type of Rack	Chassis Hole Spacing
Center mount	5-1/4 in. (13.34 cm), 7 in. (17.78 cm)
Front mount	5-1/4 in. (13.34 cm)

Rack Size and Strength

The rack must be large enough to accommodate the router's external chassis dimensions (14 in. [36 cm] high, 19 in. [48 cm] wide, and 21 in. [54 cm] deep) plus the recommended air flow clearances between the system and the rack, as listed in the section "Securing Racks" on page 41.

The rack must be strong enough to support the weight of the fully configured system, up to 134 lb (54 kg). If you install multiple routers in one standard rack, the rack must be capable of supporting the weight of all the routers.

Securing Racks

When planning rack space for the router, you should consider the following guidelines for securing racks:

- Secure the rack to the structure of the building.

- If your geographical area is subject to earthquakes, be sure that the rack is bolted to the floor.

- To maximally stabilize the system, secure the rack to ceiling brackets.

Clearance Requirements Outside the Rack

When planning the installation site, you need to allow sufficient clearance around the rack for maintenance access (see Figure 21), at least 19 in. (50 cm) in front of and behind the rack. In the front, you must allow adequate space to remove and install FPCs and the SSB. In the back, you must allow adequate space to remove and install the power supplies and the Routing Engine.

Figure 21: Chassis Dimensions (Top View) and Recommended Clearances

19" clearance required
for maintenance

20.5"

19" clearance required
for maintenance

Front of chassis

Rear of chassis

17.6"

19"

Cable managment
system

Rack-mount rails
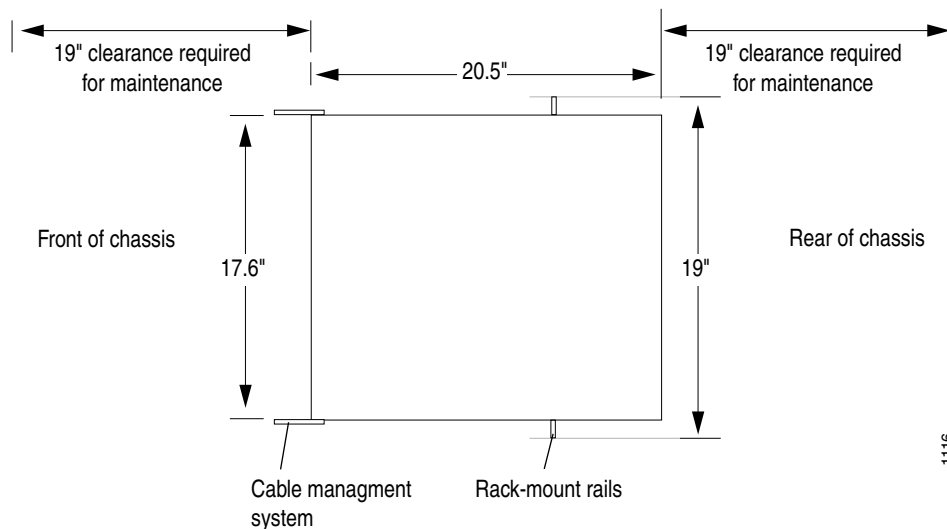
1116

Air Flow Clearance

The cooling system must have unrestricted air flow to function properly. It is recommended you allow at least 6 in. (15 cm) of clearance at the side of the rack (see Figure 21).

> **Note**
>
> The SSB and a total of four populated or blank FPCs must be installed in the router so that cooling air circulates properly throughout the card cage, thus maintaining the temperature at an acceptable level.

Figure 22: Chassis Air Flow Clearances

Fans   Front of chassis

6" for
airflow
(recommended)

6" for
airflow
(recommended)
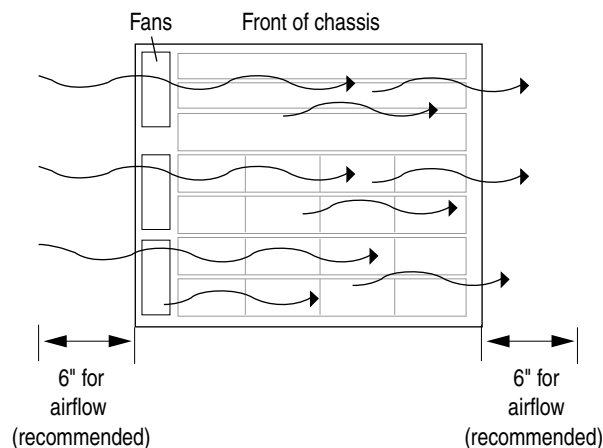
1146

Site Environmental Requirements

Table 10 lists the site environmental specifications required by the router.

Make sure that the air circulating through the router is as dust-free as possible. Dust can clog the fans, causing the cooling system to operate less efficiently.

Table 10: Site Environment Specifications

Description	Specification
Altitude	No performance degradation to 10,000 ft. (3048 m)
Relative humidity	Normal operation ensured in relative humidity range of 5% to 90%, noncondensing
Temperature	Normal operation ensured in temperature range of 0°C (32°F) to +40°C (104°F)
Shock	Tested to meet Bellcore Zone 4 earthquake requirements
Thermal output	3850 BTU/hour

Fire Safety

In the event of a fire emergency involving routers and other network equipment, the safety of people is the primary concern. You should establish procedures for protecting people in the event of a fire emergency, provide safety training, and properly provision fire-control equipment and fire extinguishers.

In addition, you should establish procedures to protect your equipment in the event of a fire emergency. Juniper Networks products should be installed in an environment suitable for electronic equipment. We recommend that fire suppression equipment be available in the event of a fire in the vicinity of the equipment, and that all local fire, safety, and electrical codes and ordinances be observed when installing and operating your equipment.

Fire Suppression

In the event of an electrical hazard or an electrical fire, you should first turn power off to the equipment at the source. Then, use a Type C fire extinguisher, which uses noncorrosive fire retardants, to extinguish the fire. For more information about fire extinguishers, see "Fire Suppression Equipment" on page 43.

Fire Suppression Equipment

Type C fire extinguishers, which use noncorrosive fire retardants such as carbon dioxide (CO_2) and Halotron™, are most effective for suppressing electrical fires. Type C fire extinguishers displace the oxygen from the point of combustion to eliminate the fire. For extinguishing fire on or around equipment that draws air from the environment for cooling, you should use this type of inert oxygen displacement extinguisher instead of an extinguisher that leave residues on equipment.

Do not use multipurpose Type ABC chemical fire extinguishers (dry chemical fire extinguishers) near Juniper Networks equipment. The primary ingredient in these fire extinguishers is monoammonium phosphate, which is very sticky and difficult to clean. In addition, in minute amounts of moisture, monoammonium phosphate can become highly corrosive and corrodes most metals.

Any equipment in a room in which a chemical fire extinguisher has been discharged is subject to premature failure and unreliable operation. The equipment is considered to be irreparably damaged.

> **Note** To keep warranties effective, do not use a dry chemical fire extinguisher to control a fire at or near a Juniper Networks router. If a dry chemical fire extinguisher is used, the unit is no longer eligible for coverage under a service agreement.

We recommend that you dispose of any irreparably damaged equipment in an environmentally responsible manner.

Power Requirements and Specifications

Each router can be equipped with two redundant, load-sharing power supplies of the same type, either DC or AC (see Figure 23 and Figure 24, respectively).

Each power supply requires a dedicated power source.

For sites with a DC power source, power is normally carried around the site through a main conduit to frame-mounted DC power distribution panels, one of which might be located at the top of the rack where the router is to be installed. A pair of cables (–48 V and RTN) connects each DC supply to the power distribution panel. Grounding studs are provided on each DC power supply.

For sites with an AC power source, each power supply has one power cord, which is plugged into a grounded 100–240 VAC power receptacle.

This section describes the following:

- Power Supply Load Sharing on page 45

- Power Supply Redundancy and Replaceability on page 45

- Power Supply LEDs on page 46

- System Power Requirements on page 46

Figure 23: DC Power Supply

Power supply
ejector

On/off switch

-48V DC

RTN

1163

Thumbscrew   Status light   Input   Return
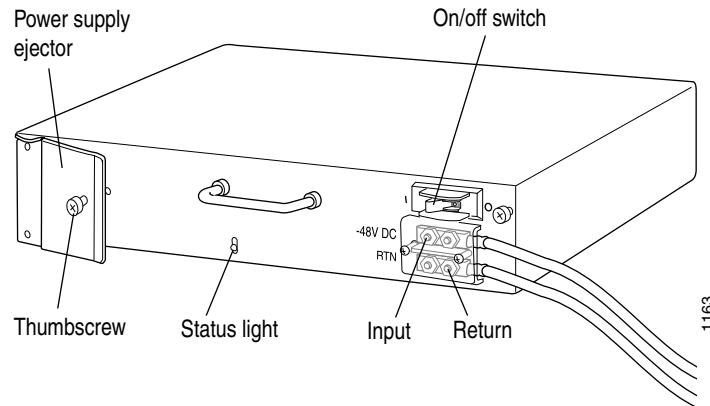
Figure 24: AC Power Supply

Thumbscrew   AC power receptacle

1162

Power supply
ejector   Status LEDs   On/off switch
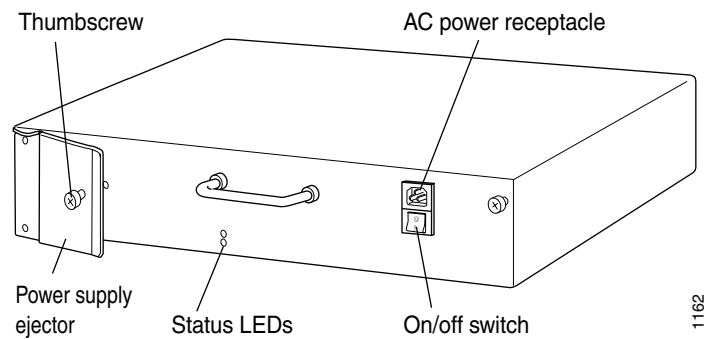
Power Supply Load Sharing

During normal operation, when both power supplies are switched on, load-sharing between them occurs automatically. This means that while an individual power supply is capable of powering the system (when two are installed) the load is distributed between them.

Power Supply Redundancy and Replaceability

The router can operate with two redundant power supplies. A single power supply unit can provide full power for as long as the system is operational. When power is shut off to one power supply, the other power supply immediately assumes the entire electrical load for the system.

Power supplies are hot-insertable and hot-removable, so you can remove one of them without powering down the system. The power supply switch must be in the off position before you can remove the power supply.

Power Supply LEDs

The faceplate on each power supply unit has two LEDs that report the status of the power supply:

- Green **OK** LED—Lights when the power supply is switched on, output voltages remain within acceptable ranges, the temperature is within acceptable range, and the fans are functioning normally.

- Red **FAIL** LED—Lights when a power supply fails.

In addition, when one or both of the power supplies are operating within an unacceptable voltage range, the **Red Alarm** LED lights on the system display panel, and the alarm relay contacts on the system display panel are activated.

System Power Requirements

Table 11 lists the power requirements for the individual hardware components under typical voltage conditions. For PIC power requirements, see *The M20 Internet Router PIC Guide.* The power requirements are the same for both the DC and AC power supplies. A UL listed circuit breaker, rated at 24 A, and 48 VDC must be provided in the building installation.

Table 11: System Power Requirements

Component	Power (Watts)
Base system (all items except the FPCs and PICs)	170 (approximate)
FPC	25.5
Fans (at full speed)	30
System and Switch Board (SSB)	50.5
Routing Engine (RE)	17

The wattage values listed in Table 11 are fairly accurate for larger, typical configurations. When the total power consumption is calculated to be less than 600 W, you should increase the number by 10 percent because the efficiency of the power supply is lower when supplying less current. The 10 percent reduction at lower power levels is an approximation. The actual reduction in efficiency is nonlinear and depends on the particular combination of PICs.

AC Power Supplies

AC power supplies have different external interfaces, power cords, and electrical specifications from DC power supplies.

<table>
<tr>
<td>⚡
Warning</td>
<td>For AC power supplies, the power cord serves as the main disconnecting device. The socket outlet must be located near the router and be easily accessible.</td>
</tr>
</table>

> ⚡ **Warning**
>
> When the router is equipped with two AC power supplies, both power cords (one on each power supply) must be removed to completely disconnect power to the router.

AC Power Supply External Interfaces and Power Cords

The AC power supply contains an AC plug receptacle, which accepts one end of the external 2-1/2–meter AC power cord that ships with the system. The other end of the AC power cord has a plug that fits into the power source receptacle that is standard for the part of the world where your site is located. There are five types of plugs (see Figure 25).

Figure 25: AC Plug Types

North America UK Italy Europe Australia
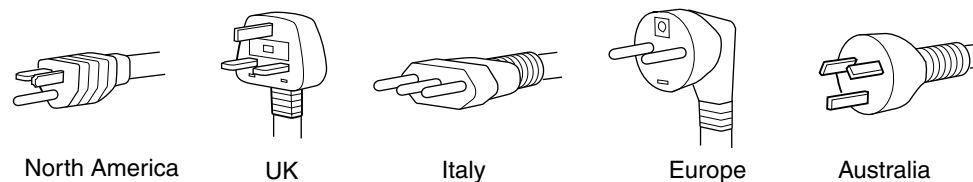
AC Power Supply Electrical Specifications

Table 12 lists the router AC power supply electrical specifications. Table 13 lists AC power cord, plug, and connector specifications. The AC power supplies have an internal fuse.

Table 12: AC Power Supply Electrical Specifications

Description	Specification
Maximum power consumption	750 watts
Input voltage	90–264 VAC operating range
Input line frequency	47–63 Hz, autoranging
Input current rating	13A @ 90V
Output voltage	+3.3V, +2.5V, +5.05V, +5V, +2.5V, +12V, +24V

Table 13: AC Power Cable Specifications

Country	Specification	Supplied	Maximum Length	Connector Specification
Australia	240 VAC, 50 Hz AC	Two sets of 2-1/2–meter cords with suitable plugs	None	IEC 320 C19
Europe	230 VAC, 50 Hz AC	Two sets of 2-1/2–meter cords with suitable plugs	None	IEC 320 C19
Italy	220 VAC, 50 Hz AC	Two sets of 2-1/2–meter cords with suitable plugs	None	IEC 320 C19

Country	Specification	Supplied	Maximum Length	Connector Specification
North America	Plug type: NEMA 5-15P 208 VAC, 60 Hz AC	Two sets of 2-1/2–meter cords with suitable plugs	None	IEC 320 C19
United Kingdom	240 VAC, 50 Hz AC	Two sets of 2-1/2–meter cords with suitable plugs	None	IEC 320 C19

DC Power Supplies

DC power supplies have different external interfaces, power cords, and electrical specifications from AC power supplies.

DC Power Supply External Interfaces and Power Cables

The DC power supply cables attach to the power supply terminal studs with cable lugs (see Figure 26). DC power cables should be 4 or 6 AWG, high-strand-count wire cable, with three leads.

Each power supply has two cable interfaces, one input and one return. The interfaces are 1/4–20 UNC terminal studs at 0.625-in. (15.86-mm) centers. Cable lugs have two holes that fit over the terminal studs. During installation, you secure the cable lugs onto the terminal studs—first with a locking washer, then a nut. A plastic protective shield, which is shipped covering the power supply terminal studs, covers the interface. You remove this shield before securing the lugs to the terminal studs.

Figure 26: DC Power Supply Cable Connectors
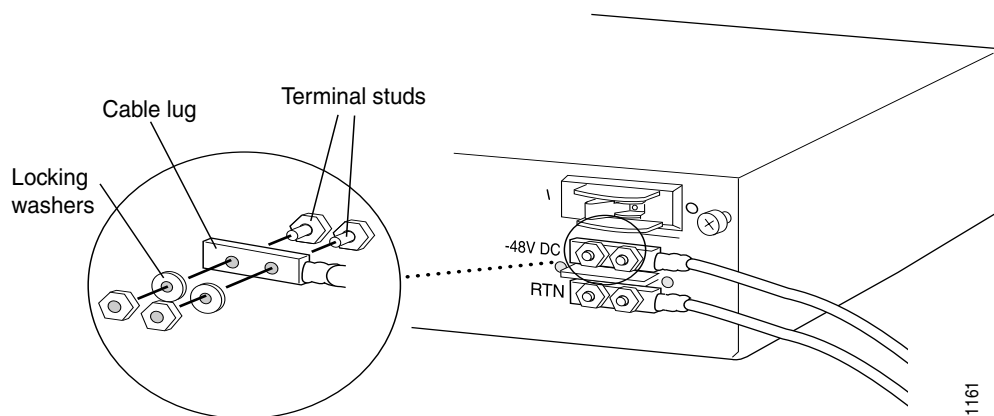
> **Note**
> DC power supplies install in restricted areas only, such as dedicated equipment rooms and equipment closets, in accordance with Articles 110-16, 110-17, and 110-18 of the National Electrical Code, ANSI/NFPA 70.

For field-wiring connections, use copper conductors only.

Note

DC Power Supply Electrical Specifications

Table 14 lists the DC power supply electrical specifications. Table 15 lists DC power cable specifications. The DC power supplies have internal circuit breakers.

After removing a power cord, double check that there are no additional power cords. Multiple power cords might be attached to the unit, and failure to remove them all before servicing the unit could result in a shock hazard.

Warning

Table 14: DC Power Supply Electrical Specifications

Description	Specification
Maximum power consumption	750 watts
DC Input voltage	–40 through –72 VDC operating range
Input DC current rating	24A @ 48VDC (typical)
Output voltage	+3.3V, +2.5V, +5.05V, +5V, +2.5V, +12V, +24V

Table 15: DC Power Supply Cable Specifications

Cable Type	Cable Specification	Supplied	Maximum Length	Other Parts Required	Connector Specification
DC power cable	4 or 6 AWG wire cables	No	None	One locking washer and nut per terminal stud	Cable lug; dual hole, sized to fit 1/4–20 UNC terminal studs at 15.86-mm (0.625-inch) center line
DC grounding cable	4 or 6 AWG wire cables	Locking washers and nuts	None	One locking washer and nut per grounding stud	Cable lug; dual hole, sized to fit 1/4–20 UNC grounding studs at 15.86-mm (0.625-inch) center line

System Grounding Guidelines

The router must be properly grounded. AC power supplies are equipped with a grounded plug, so no additional grounding is necessary on routers that use only AC power supplies. Each DC power supply must be grounded to a point on the router chassis. The chassis has a pair of threaded 10-24 grounding studs on it for attaching ground cables (see Figure 27).

To attach a ground to the grounding studs, you need the following parts:

- A dual-hole cable lug that fits over the grounding studs (see Figure 27)

- For each grounding stud, a nut and a locking washer (supplied)

- For each grounding stud, a 4/6-AWG grounding wire that is long enough to connect to the ground point

Figure 27: DC Grounding Studs

Grounding studs
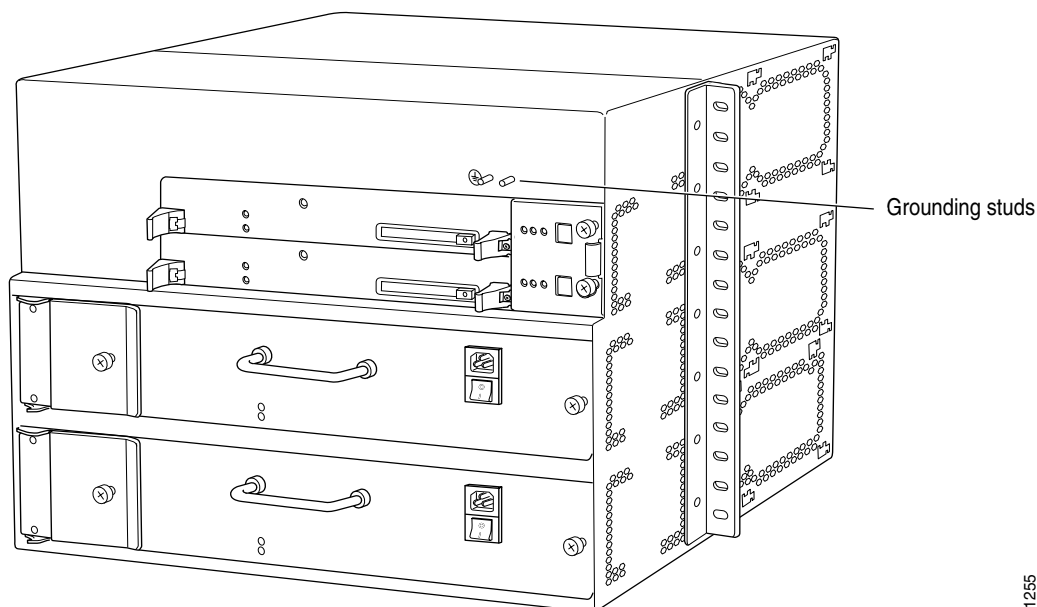
1255

Figure 28: DC Grounding Cable Connectors
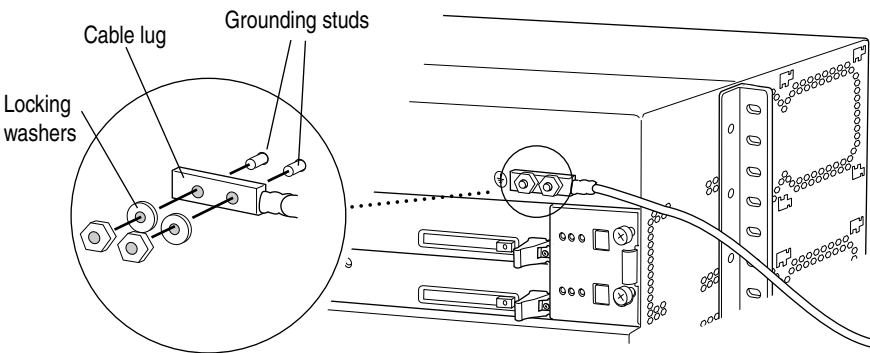
Network Cable Requirements

Table 16 lists specifications for each type of network cable used by the router. You must supply all the cables listed, unless the table indicates that the cable is shipped with the system.

Table 16: Network Cable Specifications

Cable Type	Cable Specification	Supplied	Maximum Length	Connector Specification
DS-3 interface	75-ohm coaxial	One 10-foot length	450 feet (137 meters)	Mini BNC (TBD)
Single-mode interface (fiber)	SC-SC duplex	No	Short reach: 1.25 miles (2 km) Intermediate reach: 9.3 miles (15 km)	SC SC
Multimode interface (fiber)	SC-SC duplex	No	1.25 miles (2 km)	SC
Routing Engine console interface	RS-232 serial	One 6-foot length with DB-9/DB-9 connectors	6 feet (1.83 meters)	DB-9 male
Routing Engine auxiliary interface	RS-232 serial	No	6 feet (1.83 meters)	DB-9 male
Routing Engine Ethernet interface	Category 5 cable or equivalent suitable for 100BaseT operation	One 15-foot length with RJ-45/RJ-45 connectors	328 feet (100 meters)	RJ-45

Site Wiring Guidelines

You should consider the following factors when planning the wiring and cabling at your site:

■ Distance limitations for signaling

■ Radio frequency interference

■ Electromagnetic interference

Distance Limitations for Signaling

If wires are installed improperly, they can emit radio interference. In addition, potential damage from lightning strikes increases if wires exceed recommended distances, or if wires pass between buildings. The electromagnetic pulse (EMP) caused by lightning can damage unshielded conductors and destroy electronic devices. If your site has previously experienced such problems, you might want to consult experts in electrical surge suppression and shielding.

Radio Frequency Interference

If in your plant wiring you use twisted-pair cable with a good distribution of grounding conductors, the site wiring is unlikely to emit radio frequency interference (RFI). If you exceed the recommended distances, use a high-quality twisted-pair cable with one ground conductor for each data signal when applicable.

Electromagnetic Interference

If your site is susceptible to strong electromagnetic interference (EMI), particularly from lightning or radio transmitters, you might want to seek expert advice. Strong EMI could destroy the signal drivers and receivers in the router and could conduct power surges over the lines into the equipment, resulting in an electrical hazard.

Always provide a properly grounded and shielded environment, and use electrical surge-suppression devices.

SONET/SDH and ATM Connection Guidelines

The router accommodates two types of fiber-optic cable, which are used in both SONET/SDH and ATM PIC interfaces:

■ Multimode fiber

■ Single-mode fiber

This section also discusses the following topics related to connecting fiber-optic cable:

■ Attenuation and dispersion

■ Assessing the power budget and power margin

Multimode Fiber

Multimode fiber is large enough in diameter to allow rays of light to internally reflect or bounce off the walls of the fiber. Light sources on interfaces with multimode optics are typically LEDs, which are not coherent light sources. An LED sprays varying wavelengths of light into multimode fiber, which reflects the light at different angles. Light rays travel in jagged lines through a multimode fiber, causing signal dispersion. When light traveling in the fiber core radiates into the fiber cladding, higher-order mode loss (HOL) results. All these factors limit the transmission distance of multimode fiber compared to single-mode fiber (see Table 18).

Single-Mode Fiber

Single-mode fiber is so small in diameter that there is not enough room for the rays of light passing through it to reflect internally through more than one layer. Light sources on interfaces with single-mode optics are lasers, which generate rays of light in a single wavelength and which travel in a straight line, directly through the single-mode fiber. Single-mode transmission is useful for longer distances and is capable of higher bandwidth than multimode fiber. However, it is also more expensive.

Table 17 lists the maximum distances for single-mode and multimode transmissions, as defined by SONET/SDH. Significant signal loss, causing unreliable transmission, can result if these distances are exceeded.

Table 17: Maximum Transmission Distances for Fiber-Optic Cable Types

Fiber-Optic Cable Type	Approximate Maximum Transmission Distance
Single-mode (intermediate reach)	Up to 9 miles (14.8 km)
Multimode	Up to 1.5 miles (2.0 km)

Light sources on interfaces with single-mode optics are lasers, which are coherent light sources. The router uses optical lasers for OC-3, OC-12, and OC-48 SONET/SDH PIC single-mode interfaces. These optics are compliant with IR-1 of Bellcore GR-253-CORE Issue 2, December 1995 and ANSI TI.105.06.

Table 18 lists the wavelength range supported by single-mode and multimode PIC interfaces.

Table 18: Wavelength Ranges Supported by Fiber-Optic Cable Types

Fiber-Optic Cable Type	Wavelength Range Supported
ATM	
STM-1/OC-3 ATM SMF-IR	1261–1360 nm
STM-1/OC-3 ATM MMF	1260–1360 nm
STM-4/OC-12 ATM SMF-IR	1293–1334 nm
STM-4/OC-12 ATM MMF	1261–1360 nm

Fiber-Optic Cable Type	Wavelength Range Supported
SONET/SDH	
STM-1/OC-3 SONET SMF-IR	1261–1360 nm
STM-1/OC-3 SONET MMF	1260–1360 nm
STM-4/OC-12 SONET SMF-IR	1293 –1334 nm
STM-4/OC-12 SONET MMF	1261–1360 nm
STM-16/OC-48 SONET SMF-IR	1260–1360 nm

Attenuation and Dispersion

Proper operation of an optical data link depends on modulated light reaching the receiver with enough power to be correctly demodulated. Attenuation is the reduction of the power of the light signal as it is transmitted. Attenuation is caused by passive media components, such as cables, cable splices, and connectors. While attenuation is significantly lower for optical fiber than for other media, it still occurs in both multimode and single-mode transmission. An efficient optical data link must have enough light available to overcome attenuation.

Dispersion is the spreading of the signal in time. For single-mode transmission, dispersion is negligible. For multimode transmission, however, the following two types of dispersion reduce the available power of the system by the combined dispersion penalty (in decibels [dB]):

- Chromatic dispersion—Measures the spread of the signal in time resulting from the different speeds of light rays.

- Modal dispersion—Measures the spread of the signal in time resulting from the different propagation modes in the fiber.

An efficient optical data link must have enough light available to exceed the minimum power that the receiver requires to operate within its specifications. The power lost over the optical data link is the sum of the component attenuation, chromatic dispersion, and modal dispersion losses.

Assess the Power Budget and Power Margin

The power budget (P_B) is the maximum possible amount of power that can be transmitted over the link. When you calculate the power budget, you use a worst-case analysis to provide a margin of error, although all the parts of an actual system do not operate at the worst-case levels. To calculate the worst-case estimate of power budget (P_B), you assume minimum transmitter power (P_T) and minimum receiver sensitivity (P_R).

Table 19 lists equations for calculating the power budget for SONET/SDH PIC interfaces.

Table 19: Calculating Power Budget for SONET/SDH PIC Interfaces

PIC Interface	Power Budget Equation
Multimode	$P_B = P_T - P_R$ $P_B = -15$ dBm $- (-28$ dBm$)$ $P_B = 13$ dB
OC-3 and OC-12 single-mode	$P_B = P_T - P_R$ $P_B = -15$ dBm $- (-28$ dBm$)$ $P_B = 13$ dB
OC-48 single-mode	$P_B = P_T - P_R$ $P_B = -5$ dBm $- (-18$ dBm$)$ $P_B = 13$ dB

After you have calculated the power budget, you can calculate the power margin (P_M), which estimates the amount of power available for the link after subtracting attenuation or link loss (LL) from the power budget. A worst-case estimate of P_M assumes maximum LL:

$$P_M = P_B - LL$$

A P_M greater than zero indicates that the power budget is sufficient to operate the receiver.

Table 20 lists the factors that contribute to link loss and estimates the link loss value attributable to those factors.

Table 20: Estimating Link Loss

Link-Loss Factor	Estimate of Link-Loss Value
Higher-order mode losses	Single-mode: none Multimode: 0.5 dB
Modal and chromatic dispersion	Single-mode: none Multimode: Product of bandwidth and distance must be less than 500 MHz–km
Connector	0.5 dB
Splice	0.5 dB
Fiber attenuation	Single-mode: 0.5 dB/km Multimode: 1 dB/km

Power Margin Examples

The following example calculates a multimode power margin using the following variables:

- Length of multimode link: 2 kilometers

- Number of connectors: 5

- Number of splices: 2

- Higher order loss

- Clock recovery module

Calculate the power margin as follows:

$P_M = P_B - LL$
$P_M = 13\ dB - 2\ km\ (1.0\ dB/km) - 5\ (0.5\ dB) - 2\ (0.5\ dB) - 0.5\ dB\ (HOL) - 1\ dB\ (CRM)$
$PB = 13\ dB - 2\ dB - 2.5\ dB - 1\ dB - 0.5\ dB - 1\ dB$
$P_B = 6\ dB$

The following example calculates the single-mode fiber power budget for two sites that are 8 kilometers apart, connected with single-mode SONET/SDH cable with seven connectors.

- Length of single-mode link: 8 km

- Number of connectors: 7

Calculate the power margin as follows:

$P_M = P_B - LL$
$P_M = 13\ dB - 8\ km\ (0.5\ dB/km) - 7\ (0.5\ dB)$
$P_M = 13\ dB - 4\ dB - 3.5\ dB$
$P_M = 5.5\ dB$

The calculated value of 5.5 dB indicates that this link has sufficient power for transmission and does not exceed the maximum receiver input power.

Site Preparation Checklist

To help prepare your site for installing a router, use the checklist in Table 21.

Table 21: Site Preparation Checklist

Item or Task	Prepared By	Date
Assess temperature, humidity, altitude, and other environmental requirements.		
Locate power sources, and measure the distance to system installation site.		
Select the type of rack to be used.		
Measure space for the rack, including specified maintenance clearances.		
Acquire specified cables and connectors.		
Locate sites for connection of system grounding.		
Secure rack to the floor and building structure.		
Assess the power budget and power margin for your site.		

Chapter 6
Regulatory Compliance and Safety Information

To safely install and use the router, you should understand the safety warnings and follow proper safety guidelines. This chapter provides regulatory compliance and safety information for the M20 Internet Router:

- Definition of Safety Warnings on page 58

- Qualified Personnel Warning on page 60

- Safety Recommendations on page 60

- Installation Warning on page 61

- Restricted Access Area Warning on page 62

- Ramp Warning on page 63

- Chassis Lifting Guidelines and Warnings on page 63

- Rack-Mounting Requirements and Warnings on page 64

- Operating Temperature Warning on page 68

- Electricity Safety Guidelines on page 69

- Laser Safety Guidelines on page 81

- Product Disposal Warning on page 84

- Lightning Activity Warning on page 85

- Jewelry Removal Warning on page 86

- TN and IT Power Warning on page 87

- Battery Handling Warning on page 88

- Agency Approvals on page 88

- Compliance Statements for EMC Requirements on page 90

⚡
Warning

Only trained service personnel should install the equipment.

⚡
Warning

Read the installation instructions before you connect the equipment to its power source.

Definition of Safety Warnings

The following notes indicate two levels of precautionary guidelines:

!
Caution

Failure to observe guidelines included in a cautionary note could result in minor injury or discomfort to you or severe damage to the router.

⚡
Warning

Means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents.

Waarschuwing Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van standaard maatregelen om ongelukken te voorkomen.

Varoitus Tämä varoitusmerkki merkitsee vaaraa. Olet tilanteessa, joka voi johtaa ruumiinvammaan. Ennen kuin työskentelet minkään laitteiston parissa, ota selvää sähkökytkentöihin liittyvistä vaaroista ja tavanomaisista onnettomuuksien ehkäisykeinoista.

Attention Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant causer des blessures ou des dommages corporels. Avant de travailler sur un équipement, soyez conscient des dangers posés par les circuits électriques et familiarisez-vous avec les procédures couramment utilisées pour éviter les accidents.

Warnung Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu einer Körperverletzung führen könnte. Bevor Sie mit der Arbeit an irgendeinem Gerät beginnen, seien Sie sich der mit elektrischen Stromkreisen verbundenen Gefahren und der Standardpraktiken zur Vermeidung von Unfällen bewußt.

Warning

Avvertenza Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di lavorare su qualsiasi apparecchiatura, occorre conoscere i pericoli relativi ai circuiti elettrici ed essere al corrente delle pratiche standard per la prevenzione di incidenti.

Advarsel Dette varselsymbolet betyr fare. Du befinner deg i en situasjon som kan føre til personskade. Før du utfører arbeid på utstyr, må du vare oppmerksom på de faremomentene som elektriske kretser innebærer, samt gjøre deg kjent med vanlig praksis når det gjelder å unngå ulykker.

Aviso Este símbolo de aviso indica perigo. Encontra-se numa situação que lhe poderá causar danos físicos. Antes de começar a trabalhar com qualquer equipamento, familiarize-se com os perigos relacionados com circuitos eléctricos, e com quaisquer práticas comuns que possam prevenir possíveis acidentes.

¡Atención! Este símbolo de aviso significa peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considerar los riesgos que entraña la corriente eléctrica y familiarizarse con los procedimientos estándar de prevención de accidentes.

Varning! Denna varningssymbol signalerar fara. Du befinner dig i en situation som kan leda till personskada. Innan du utför arbete på någon utrustning måste du vara medveten om farorna med elkretsar och känna till vanligt förfarande för att förebygga skador.

Qualified Personnel Warning

Only trained and qualified personnel should install or replace the router.

Waarschuwing Installatie en reparaties mogen uitsluitend door getraind en bevoegd personeel uitgevoerd worden.

Varoitus Ainoastaan koulutettu ja pätevä henkilökunta saa asentaa tai vaihtaa tämän laitteen.

Avertissement Tout installation ou remplacement de l'appareil doit être réalisé par du personnel qualifié et compétent.

Achtung Gerät nur von geschultem, qualifiziertem Personal installieren oder auswechseln lassen.

Avvertenza Solo personale addestrato e qualificato deve essere autorizzato ad installare o sostituire questo apparecchio.

Advarsel Kun kvalifisert personell med riktig opplæring bør montere eller bytte ut dette utstyret.

Aviso Este equipamento deverá ser instalado ou substituído apenas por pessoal devidamente treinado e qualificado.

¡Atención! Estos equipos deben ser instalados y reemplazados exclusivamente por personal técnico adecuadamente preparado y capacitado.

Varning Denna utrustning ska endast installeras och bytas ut av utbildad och kvalificerad personal.

Safety Recommendations

The following guidelines help ensure your safety and protect the router. The list of guidelines might not address all potentially hazardous situations in your working environment, so be alert, and exercise good judgement at all times.

- Perform only those system services that are explicitly described in this installation guide. Make sure that only authorized service personnel perform other system services.

- Keep the chassis area clear and free from dust before, during, and after installation.

- Keep tools away from areas where people could trip over them while walking.

- Do not wear loose clothing or jewelry, such as rings, bracelets, or chains, which may become caught in the chassis.

- Wear safety glasses if you are working under any conditions that may be hazardous to your eyes.

- Do not perform any actions that create a potential hazard to people or make the equipment unsafe.

- Never attempt to lift an object that is too heavy for one person to handle.

- Never install wiring during electrical storms.

- Never install electrical jacks in wet locations unless the jacks are specifically designed for wet environments.

- Operate the router only when the grounding wire is connected.

- Replace fuses only with fuses of the same type and rating.

- Do not open or remove chassis covers or sheet metal parts when instructions are not provided in this manual. Such an action could cause severe electrical shock.

- Do not push or force any objects through any of the openings in the chassis frame. Such an action could result in electrical shock or fire.

- Avoid spilling liquid onto the router chassis or onto any router component. Such an action could cause electrical shock or damage the router.

- Avoid touching uninsulated electrical wires or terminals that have not been disconnected from their power source. Such an action could cause electrical shock.

Installation Warning

Read the installation instructions before you connect the router to a power source.

Waarschuwing   Raadpleeg de installatie-aanwijzingen voordat u het systeem met de voeding verbindt.

Varoitus   Lue asennusohjeet ennen järjestelmän yhdistämistä virtalähteeseen.

Attention   Avant de brancher le système sur la source d'alimentation, consulter les directives d'installation.

Warnung   Lesen Sie die Installationsanweisungen, bevor Sie das System an die Stromquelle anschließen.

Avvertenza   Consultare le istruzioni di installazione prima di collegare il sistema all'alimentatore.

Advarsel   Les installasjonsinstruksjonene før systemet kobles til strømkilden.

Aviso   Leia as instruções de instalação antes de ligar o sistema à sua fonte de energia.

¡Atención!   Ver las instrucciones de instalación antes de conectar el sistema a la red de alimentación.

Varning!   Läs installationsanvisningarna innan du kopplar systemet till dess strömförsörjningsenhet.

Restricted Access Area Warning

Warning

The router is intended for installation in restricted access areas. A restricted access area is an area to which access can be gained only by service personnel through the use of a special tool, lock and key, or other means of security, and that is controlled by the authority responsible for the location.

Waarschuwing   Dit toestel is bedoeld voor installatie op plaatsen met beperkte toegang. Een plaats met beperkte toegang is een plaats waar toegang slechts door servicepersoneel verkregen kan worden door middel van een speciaal instrument, een slot en sleutel, of een ander veiligheidsmiddel, en welke beheerd wordt door de overheidsinstantie die verantwoordelijk is voor de locatie.

Varoitus   Tämä laite on tarkoitettu asennettavaksi paikkaan, johon pääsy on rajoitettua. Paikka, johon pääsy on rajoitettua, tarkoittaa paikkaa, johon vain huoltohenkilöstö pääsee jonkin erikoistyökalun, lukkoon sopivan avaimen tai jonkin muun turvalaitteen avulla ja joka on paikasta vastuussa olevien toimivaltaisten henkilöiden valvoma.

Attention   Cet appareil est à installer dans des zones d'accès réservé. Ces dernières sont des zones auxquelles seul le personnel de service peut accéder en utilisant un outil spécial, un mécanisme de verrouillage et une clé, ou tout autre moyen de sécurité. L'accès aux zones de sécurité est sous le contrôle de l'autorité responsable de l'emplacement.

Warnung   Diese Einheit ist zur Installation in Bereichen mit beschränktem Zutritt vorgesehen. Ein Bereich mit beschränktem Zutritt ist ein Bereich, zu dem nur Wartungspersonal mit einem Spezialwerkzeugs, Schloß und Schlüssel oder anderer Sicherheitsvorkehrungen Zugang hat, und der von dem für die Anlage zuständigen Gremium kontrolliert wird.

Avvertenza   Questa unità deve essere installata in un'area ad accesso limitato. Un'area ad accesso limitato è un'area accessibile solo a personale di assistenza tramite un'attrezzo speciale, lucchetto, o altri dispositivi di sicurezza, ed è controllata dall'autorità responsabile della zona.

Advarsel   Denne enheten er laget for installasjon i områder med begrenset adgang. Et område med begrenset adgang gir kun adgang til servicepersonale som bruker et spesielt verktøy, lås og nøkkel, eller en annen sikkerhetsanordning, og det kontrolleres av den autoriteten som er ansvarlig for området.

Aviso   Esta unidade foi concebida para instalação em áreas de acesso restrito. Uma área de acesso restrito é uma área à qual apenas tem acesso o pessoal de serviço autorizado, que possua uma ferramenta, chave e fechadura especial, ou qualquer outra forma de segurança. Esta área é controlada pela autoridade responsável pelo local.

¡Advertencia!   Esta unidad ha sido diseñada para instalarse en áreas de acceso restringido. Área de acceso restringido significa un área a la que solamente tiene acceso el personal de servicio mediante la utilización de una herramienta especial, cerradura con llave, o algún otro medio de seguridad, y que está bajo el control de la autoridad responsable del local.

Varning!   Denna enhet är avsedd för installation i områden med begränsat tillträde. Ett område med begränsat tillträde får endast tillträdas av servicepersonal med ett speciellt verktyg, lås och nyckel, eller annan säkerhetsanordning, och kontrolleras av den auktoritet som ansvarar för området.

Ramp Warning

When moving the router, do not use a ramp inclined at more than 10 degrees.

Waarschuwing   Gebruik een oprijplaat niet onder een hoek van meer dan 10 graden.

Varoitus   Älä käytä sellaista kaltevaa pintaa, jonka kaltevuus ylittää 10 astetta.

Attention   Ne pas utiliser une rampe dont l'inclinaison est supérieure à 10 degrés.

Warnung   Keine Rampen mit einer Neigung von mehr als 10 Grad verwenden.

Avvertenza   Non usare una rampa con pendenza superiore a 10 gradi.

Advarsel   Bruk aldri en rampe som heller mer enn 10 grader.

Aviso   Não utilize uma rampa com uma inclinação superior a 10 graus.

¡Advertencia!   No usar una rampa inclinada más de 10 grados.

Varning!   Använd inte ramp med en lutning på mer än 10 grader.

Chassis Lifting Guidelines and Warnings

A fully configured router weighs about 134 lb (61 kg). Observe the following guidelines for lifting and moving the system:

- Before moving the router, read the site preparation guidelines in "Prepare the Site" on page 39 to ensure that the intended site meets the specified power, environmental, and clearance requirements.

- Before lifting or moving the router, disconnect all external cables.

- The router must be lifted by a minimum of two people, and the components must be removed before lifting (as described in "Remove Components from the Chassis" on page 98).

- As when lifting any heavy object, lift most of the weight with your legs rather than your back. Keep your knees bent and your back relatively straight and avoid twisting as you lift. Balance the load evenly and be sure that your footing is solid.

Two people at minimum are required to lift the chassis. Before lifting the chassis, remove components as described in "Remove Components from the Chassis" on page 98. To prevent injury, keep your back straight and lift with your legs, not your back. Do not attempt to lift the chassis with the handles on the power supplies

Rack-Mounting Requirements and Warnings

Make sure that rack-mounting the router does not create a hazardous condition because of uneven mechanical loading. Ensure that any equipment rack is evenly and securely supported.

Warning

The router must be installed into a rack that is secured to the building structure.

Waarschuwing   De Juniper Networks M20 router moet in een stellage worden geïnstalleerd die aan een bouwsel is verankerd.

Varoitus   Juniper Networks M20 router on asennettava telineeseen, joka on kiinnitetty rakennukseen.

Attention   Le rack sur lequel est monté le Juniper Networks M20 router doit être fixé à la structure du bâtiment.

Warnung   Der Juniper Networks M20 router muß in einem Gestell installiert werden, das in der Gebäudestruktur verankert ist.

Avvertenza   Il Juniper Networks M20 router deve essere installato in un telaio, il quale deve essere fissato alla struttura dell'edificio.

Advarsel   Juniper Networks M20 router må installeres i et stativ som er forankret til bygningsstrukturen.

Aviso   O Juniper Networks M20 router deverá ser instalado numa prateleira fixa à estrutura do edificio.

¡Advertencia!   El Juniper Networks M20 router debe instalarse en un bastidor fijado a la estructura del edificio.

Varning!   Juniper Networks M20 router måste installeras i en ställning som är förankrad i byggnadens struktur.

Warning

To prevent bodily injury when mounting or servicing the router in a rack, take the following precautions to ensure that the system remains stable:

The router should be mounted at the bottom of the rack if it is the only unit in the rack.

When mounting the router in a partially filled rack, load the rack from the bottom to the top with the heaviest component at the bottom of the rack.

If the rack is provided with stabilizing devices, install the stabilizers before mounting or servicing the router in the rack.

Waarschuwing   Om lichamelijk letsel te voorkomen wanneer u dit toestel in een rek monteert of het daar een servicebeurt geeft, moet u speciale voorzorgsmaatregelen nemen om ervoor te zorgen dat het toestel stabiel blijft. De onderstaande richtlijnen worden verstrekt om uw veiligheid te verzekeren:

Dit toestel dient onderaan in het rek gemonteerd te worden als het toestel het enige in het rek is.

Wanneer u dit toestel in een gedeeltelijk gevuld rek monteert, dient u het rek van onderen naar boven te laden met het zwaarste onderdeel onderaan in het rek.

Als het rek voorzien is van stabiliseringshulpmiddelen, dient u de stabilisatoren te monteren voordat u het toestel in het rek monteert of het daar een servicebeurt geeft.

Varoitus   Kun laite asetetaan telineeseen tai huolletaan sen ollessa telineessä, on noudatettava erityisiä varotoimia järjestelmän vakavuuden säilyttämiseksi, jotta vältytään loukkaantumiselta. Noudata seuraavia turvallisuusohjeita:

Jos telineessä ei ole muita laitteita, aseta laite telineen alaosaan.

Jos laite asetetaan osaksi täytettyyn telineeseen, aloita kuormittaminen sen alaosasta kaikkein raskaimmalla esineellä ja siirry sitten sen yläosaan.

Jos telinettä varten on vakaimet, asenna ne ennen laitteen asettamista telineeseen tai sen huoltamista siinä.

Attention   Pour éviter toute blessure corporelle pendant les opérations de montage ou de réparation de cette unité en casier, il convient de prendre des précautions spéciales afin de maintenir la stabilité du système. Les directives ci-dessous sont destinées à assurer la protection du personnel :

Si cette unité constitue la seule unité montée en casier, elle doit être placée dans le bas.

Si cette unité est montée dans un casier partiellement rempli, charger le casier de bas en haut en plaçant l'élément le plus lourd dans le bas.

Si le casier est équipé de dispositifs stabilisateurs, installer les stabilisateurs avant de monter ou de réparer l'unité en casier.

Warning

Warnung   Zur Vermeidung von Körperverletzung beim Anbringen oder Warten dieser Einheit in einem Gestell müssen Sie besondere Vorkehrungen treffen, um sicherzustellen, daß das System stabil bleibt. Die folgenden Richtlinien sollen zur Gewährleistung Ihrer Sicherheit dienen:

Wenn diese Einheit die einzige im Gestell ist, sollte sie unten im Gestell angebracht werden.

Bei Anbringung dieser Einheit in einem zum Teil gefüllten Gestell ist das Gestell von unten nach oben zu laden, wobei das schwerste Bauteil unten im Gestell anzubringen ist.

Wird das Gestell mit Stabilisierungszubehör geliefert, sind zuerst die Stabilisatoren zu installieren, bevor Sie die Einheit im Gestell anbringen oder sie warten.

Avvertenza   Per evitare infortuni fisici durante il montaggio o la manutenzione di questa unità in un supporto, occorre osservare speciali precauzioni per garantire che il sistema rimanga stabile. Le seguenti direttive vengono fornite per garantire la sicurezza personale:

Questa unità deve venire montata sul fondo del supporto, se si tratta dell'unica unità da montare nel supporto.

Quando questa unità viene montata in un supporto parzialmente pieno, caricare il supporto dal basso all'alto, con il componente più pesante sistemato sul fondo del supporto.

Se il supporto è dotato di dispositivi stabilizzanti, installare tali dispositivi prima di montare o di procedere alla manutenzione dell'unità nel supporto.

Advarsel   Unngå fysiske skader under montering eller reparasjonsarbeid på denne enheten når den befinner seg i et kabinett. Vær nøye med at systemet er stabilt. Følgende retningslinjer er gitt for å verne om sikkerheten:

Denne enheten bør monteres nederst i kabinettet hvis dette er den eneste enheten i kabinettet.

Ved montering av denne enheten i et kabinett som er delvis fylt, skal kabinettet lastes fra bunnen og opp med den tyngste komponenten nederst i kabinettet.

Hvis kabinettet er utstyrt med stabiliseringsutstyr, skal stabilisatorene installeres før montering eller utføring av reparasjonsarbeid på enheten i kabinettet.

Aviso   Para se prevenir contra danos corporais ao montar ou reparar esta unidade numa estante, deverá tomar precauções especiais para se certificar de que o sistema possui um suporte estável. As seguintes directrizes ajudá-lo-ão a efectuar o seu trabalho com segurança:

Esta unidade deverá ser montada na parte inferior da estante, caso seja esta a única unidade a ser montada.

Ao montar esta unidade numa estante parcialmente ocupada, coloque os itens mais pesados na parte inferior da estante, arrumando-os de baixo para cima.

Se a estante possuir um dispositivo de estabilização, instale-o antes de montar ou reparar a unidade.

Warning

¡Advertencia! Para evitar lesiones durante el montaje de este equipo sobre un bastidor, o posteriormente durante su mantenimiento, se debe poner mucho cuidado en que el sistema quede bien estable. Para garantizar su seguridad, proceda según las siguientes instrucciones:

Colocar el equipo en la parte inferior del bastidor, cuando sea la única unidad en el mismo.

Cuando este equipo se vaya a instalar en un bastidor parcialmente ocupado, comenzar la instalación desde la parte inferior hacia la superior colocando el equipo más pesado en la parte inferior.

Si el bastidor dispone de dispositivos estabilizadores, instalar éstos antes de montar o proceder al mantenimiento del equipo instalado en el bastidor.

Varning! För att undvika kroppsskada när du installerar eller utför underhållsarbete på denna enhet på en ställning måste du vidta särskilda försiktighetsåtgärder för att försäkra dig om att systemet står stadigt. Följande riktlinjer ges för att trygga din säkerhet:

Om denna enhet är den enda enheten på ställningen skall den installeras längst ned på ställningen.

Om denna enhet installeras på en delvis fylld ställning skall ställningen fyllas nedifrån och upp, med de tyngsta enheterna längst ned på ställningen.

Om ställningen är försedd med stabiliseringsdon skall dessa monteras fast innan enheten installeras eller underhålls på ställningen.

Operating Temperature Warning

Warning

To prevent the router from overheating, do not operate it in an area that exceeds the maximum recommended ambient temperature of 104°F (40°C). To prevent airflow restriction, allow at least 6 inches (15.2 cm) of clearance around the ventilation openings.

Waarschuwing Om te voorkomen dat welke router van de Juniper Networks M20 router dan ook oververhit raakt, dient u deze niet te bedienen op een plaats waar de maximale aanbevolen omgevingstemperatuur van 40°C wordt overschreden. Om te voorkomen dat de luchtstroom wordt beperkt, dient er minstens 15,2 cm speling rond de ventilatie-openingen te zijn.

Varoitus Ettei Juniper Networks M20 router-sarjan reititin ylikuumentuisi, sitä ei saa käyttää tilassa, jonka lämpötila ylittää korkeimman suositellun ympäristölämpötilan 40°C. Ettei ilmanvaihto estyisi, tuuletusaukkojen ympärille on jätettävä ainakin 15,2 cm tilaa.

Attention Pour éviter toute surchauffe des routeurs de la gamme Juniper Networks M20M20 router, ne l'utilisez pas dans une zone où la température ambiante est supérieure à 40°C. Pour permettre un flot d'air constant, dégagez un espace d'au moins 15 cm autour des ouvertures de ventilations.

Warnung Um einen Router der router vor Überhitzung zu schützen, darf dieser nicht in einer Gegend betrieben werden, in der die Umgebungstemperatur das empfohlene Maximum von 40°C überschreitet. Um Lüftungsverschluß zu verhindern, achten Sie darauf, daß mindestens 15,2 cm lichter Raum um die Lüftungsöffnungen herum frei bleibt.

Avvertenza Per evitare il surriscaldamento dei router, non adoperateli in un locale che ecceda la temperatura ambientale massima di 104°F (40°C). Per evitare che la circolazione dell'aria sia impedita, lasciate uno spazio di almeno sei pollici (15.2 cm) di fronte alle aperture delle ventole.

Advarsel Unngå overoppheting av eventuelle rutere i Juniper Networks M20 router Disse skal ikke brukes på steder der den anbefalte maksimale omgivelsestemperaturen overstiger 40°C (104°F). Sørg for at klaringen rundt lufteåpningene er minst 15,2 cm (6 tommer) for å forhindre nedsatt luftsirkulasjon.

Aviso Para evitar o sobreaquecimento do encaminhador Juniper Networks M20 router, não utilize este equipamento numa área que exceda a temperatura máxima recomendada de 40°C. Para evitar a restrição à circulação de ar, deixe pelo menos um espaço de 15,2 cm à volta das aberturas de ventilação.

¡Advertencia! Para impedir que un encaminador de la serie Juniper Networks M20 router se recaliente, no lo haga funcionar en un área en la que se supere la temperatura ambiente máxima recomendada de 104°F (40°C). Para impedir la restricción de la entrada de aire, deje un espacio mínimo de 6 pulgadas (15,2 cm) alrededor de las aperturas para ventilación.

Varning! Förhindra att en Juniper Networks M20 router överhettas genom att inte använda den i ett område där den maximalt rekommenderade omgivningstemperaturen på 40°C överskrids. Förhindra att luftcirkulationen inskränks genom att se till att det finns fritt utrymme på minst 15,2 cm omkring ventilationsöppningarna.

Electricity Safety Guidelines

> ⚠ **Warning**
>
> On an AC-powered router, unplug the power cords before working on a chassis or working near the power supplies. On a DC-powered system, disconnect the power at the circuit breakers.

When working on equipment powered by electricity, follow these guidelines:

- Locate the emergency power-off switch for the room in which you are working so that if an electrical accident occurs, you can quickly turn off the power.

- Do not work alone if potentially hazardous conditions exist anywhere in your workspace.

- Never assume that power is disconnected from a circuit. Always check the circuit before starting to work.

- Carefully look for possible hazards in your work area, such as moist floors, ungrounded power extension cords, and missing safety grounds.

- Operate the router within its marked electrical ratings and product usage instructions.

- Install the router with the following local, national, or international electrical codes:

    - United States—National Fire Protection Association (NFPA70), United States National Electrical Code.

    - Canada—Canadian Electrical Code, Part 1, CSA C22.1.

    - Other countries—International Electromechanical Commission (IEC) 364, Part 1 through Part 7.

    - Evaluated to the TN and IT power systems.

The SFMs, Routing Engines, MCS, PCGs FPCs, PICs, power supplies, and cooling system components can be removed and replaced without powering down or disconnecting power to the router. Observe the following guidelines for maintaining electrical safety:

- Never install equipment if it appears damaged.

- Periodically inspect the installation site for potential hazards such as wet floors and for ungrounded power extension cords.

In Case of Electrical Accident

In the event of an electrical accident resulting in an injury, take the following actions in this order:

1. Use caution—Be aware of all hazards around you.

2. Disconnect power from the router.

3. If possible, send another person to get medical aid. Otherwise, assess the condition of the victim then call for help.

Power and Grounding Requirements

For the router and peripheral equipment to function safely and correctly, use the cables and connectors specified for the attached peripheral equipment, and make certain they are in good condition.

An insulated grounding conductor that is identical in size to the grounded and ungrounded branch circuit supply conductors, but is identifiable by green and yellow stripes, is installed as part of the branch circuit that supplies the unit. The grounding conductor is a separately derived system at the supply transformer or motor generator set.

Ground Connection Warning

Warning

When installing the router, the ground connection must always be made first and disconnected last.

Waarschuwing   Bij de installatie van het toestel moet de aardverbinding altijd het eerste worden gemaakt en het laatste worden losgemaakt.

Varoitus   Laitetta asennettaessa on maahan yhdistäminen aina tehtävä ensiksi ja maadoituksen irti kytkeminen viimeiseksi.

Attention   Lors de l'installation de l'appareil, la mise à la terre doit toujours être connectée en premier et déconnectée en dernier.

Warnung   Der Erdanschluß muß bei der Installation der Einheit immer zuerst hergestellt und zuletzt abgetrennt werden.

Avvertenza   In fase di installazione dell'unità, eseguire sempre per primo il collegamento a massa e disconnetterlo per ultimo.

Advarsel   Når enheten installeres, må jordledningen alltid tilkobles først og frakobles sist.

Aviso   Ao instalar a unidade, a ligação à terra deverá ser sempre a primeira a ser ligada, e a última a ser desligada.

¡Advertencia!   Al instalar el equipo, conectar la tierra la primera y desconectarla la última.

Varning!   Vid installation av enheten måste jordledningen alltid anslutas först och kopplas bort sist.

Grounded Equipment Warning

Warning

The router is intended to be grounded. Ensure that the router is connected to earth ground during normal use.

Waarschuwing   Deze apparatuur hoort geaard te worden Zorg dat de host-computer tijdens normaal gebruik met aarde is verbonden.

Varoitus   Tämä laitteisto on tarkoitettu maadoitettavaksi. Varmista, että isäntälaite on yhdistetty maahan normaalikäytön aikana.

Attention   Cet équipement doit être relié à la terre. S'assurer que l'appareil hôte est relié à la terre lors de l'utilisation normale.

Warnung   Dieses Gerät muß geerdet werden. Stellen Sie sicher, daß das Host-Gerät während des normalen Betriebs an Erde gelegt ist.

Avvertenza   Questa apparecchiatura deve essere collegata a massa. Accertarsi che il dispositivo host sia collegato alla massa di terra durante il normale utilizzo.

Advarsel   Dette utstyret skal jordes. Forviss deg om vertsterminalen er jordet ved normalt bruk.

Aviso   Este equipamento deverá estar ligado à terra. Certifique-se que o host se encontra ligado à terra durante a sua utilização normal.

¡Advertencia!   Este equipo debe conectarse a tierra. Asegurarse de que el equipo principal esté conectado a tierra durante el uso normal.

Varning!   Denna utrustning är avsedd att jordas. Se till att värdenheten är jordad vid normal användning.

Power Supply Disconnection Warning

Warning

The router has more than one power supply connection. All connections must be removed completely to remove power from the unit completely.

Waarschuwing   Voordat u aan een frame of in de nabijheid van voedingen werkt, dient u bij wisselstroom toestellen de stekker van het netsnoer uit het stopcontact te halen; voor gelijkstroom toestellen dient u de stroom uit te schakelen bij de stroomverbreker.

Varoitus   Kytke irti vaihtovirtalaitteiden virtajohto ja katkaise tasavirtalaitteiden virta suojakytkimellä, ennen kuin teet mitään asennuspohjalle tai työskentelet virtalähteiden läheisyydessä.

Attention   Avant de travailler sur un châssis ou à proximité d'une alimentation électrique, débrancher le cordon d'alimentation des unités en courant alternatif ; couper l'alimentation des unités en courant continu au niveau du disjoncteur.

Warnung   Bevor Sie an einem Chassis oder in der Nähe von Netzgeräten arbeiten, ziehen Sie bei Wechselstromeinheiten das Netzkabel ab bzw. schalten Sie bei Gleichstromeinheiten den Strom am Unterbrecher ab.

Avvertenza   Prima di lavorare su un telaio o intorno ad alimentatori, scollegare il cavo di alimentazione sulle unità CA; scollegare l'alimentazione all'interruttore automatico sulle unità CC.

Advarsel   Før det utføres arbeid på kabinettet eller det arbeides i nærheten av str¿mforsyningsenheter, skal str¿mledningen trekkes ut p vekselstrømsenheter og strømmen kobles fra ved strømbryteren på likestrømsenheter.

Aviso   Antes de trabalhar num chassis, ou antes de trabalhar perto de unidades de fornecimento de energia, desligue o cabo de alimentação nas unidades de corrente alternada; desligue a corrente no disjuntor nas unidades de corrente contínua.

¡Advertencia!   Antes de manipular el chasis de un equipo o trabajar cerca de una fuente de alimentación, desenchufar el cable de alimentación en los equipos de corriente alterna (CA); cortar la alimentación desde el interruptor automático en los equipos de corriente continua (CC).

Varning!   Innan du arbetar med ett chassi eller nära strömförsörjningsenheter skall du för växelströmsenheter dra ur nätsladden och för likströmsenheter bryta strömmen vid överspänningsskyddet.

Power Supply Connection Warning

Warning

The router has more than one power supply connection. All connections must be removed completely to completely remove power from the unit.

Waarschuwing   Deze eenheid heeft meer dan één stroomtoevoerverbinding; alle verbindingen moeten volledig worden verwijderd om de stroom van deze eenheid volledig te verwijderen.

Varoitus   Tässä laitteessa on useampia virtalähdekytkentöjä. Kaikki kytkennät on irrotettava kokonaan, jotta virta poistettaisiin täysin laitteesta.

Attention   Cette unité est équipée de plusieurs raccordements d'alimentation. Pour supprimer tout courant électrique de l'unité, tous les cordons d'alimentation doivent être débranchés.

Warnung   Diese Einheit verfügt über mehr als einen Stromanschluß; um Strom gänzlich von der Einheit fernzuhalten, müssen alle Stromzufuhren abgetrennt sein.

Avvertenza   Questa unità ha più di una connessione per alimentatore elettrico; tutte le connessioni devono essere completamente rimosse per togliere l'elettricità dall'unità.

Advarsel   Denne enheten har mer enn én strømtilkobling. Alle tilkoblinger må kobles helt fra for å eliminere strøm fra enheten.

Aviso   Este dispositivo possui mais do que uma conexão de fonte de alimentação de energia; para poder remover a fonte de alimentação de energia, deverão ser desconectadas todas as conexões existentes.

¡Advertencia!   Esta unidad tiene más de una conexión de suministros de alimentación; para eliminar la alimentación por completo, deben desconectarse completamente todas las conexiones.

Varning!   Denna enhet har mer än en strömförsörjningsanslutning; alla anslutningar måste vara helt avlägsnade innan strömtillförseln till enheten är fullständigt bruten.

Copper Conductors Warning

Warning

Use copper conductors only.

Waarschuwing   Gebruik alleen koperen geleiders.

Varoitus   Käytä vain kuparijohtimia.

Attention   Utilisez uniquement des conducteurs en cuivre.

Warnung   Verwenden Sie ausschließlich Kupferleiter.

Avvertenza   Usate unicamente dei conduttori di rame.

Advarsel   Bruk bare kobberledninger.

Aviso   Utilize apenas fios condutores de cobre.

¡Advertencia!   Emplee sólo conductores de cobre.

Varning!   Använd endast ledare av koppar.

Guidelines for AC-Powered Routers

When working with AC-powered routers, follow these guidelines:

- AC-powered routers are shipped with a three-wire electrical cord with a grounding-type plug that fits only a grounding-type power outlet. Do not circumvent this safety feature. Equipment grounding should comply with local and national electrical codes.

- You must provide an external circuit breaker rated minimum 20 A, 125/250 VAC in the building installation.

- The power cord serves as the main disconnecting device. The socket outlet must be near the router and be easily accessible.

- The cores in the main leads are colored in accordance with the following code:

  - Green and yellow—Earth

  - Blue—Neutral

  - Brown—Live

- When a router is equipped with two AC power supplies, both power cords (one on each power supply) must be removed to completely disconnect power to the router.

Guidelines for DC-Powered Routers

When working with DC-powered routers, follow these guidelines:

- DC-powered routers are equipped with a DC terminal block. You must terminate the DC input wiring on a DC source capable of supplying at least 65 A. A 90 A circuit breaker is required at the 48 VDC facility power source. An easily accessible disconnect device should be incorporated into the facility wiring. Be sure to connect the grounding wire conduit to a solid earth ground. A closed loop ring is recommended to terminate the ground conductor at the ground stud.

- Run two wires from the circuit breaker box to a source of 48 VDC. Use appropriate gauge wire to handle up to 90 A.

- You must connect only a DC power source that complies with the safety extra low-voltage (SELV) requirements of UL 1950, CSA C22.2 No. 950-95, EN 60950 and IEC 60950 to a DC-input terminal block.

- A DC-powered router that is equipped with a DC terminal block is intended only for installation in a restricted access location. In the United States, a restricted access area is one in accordance with Articles 110-16, 110-17, and 110-18 of the National Electrical Code ANSI/NFPA 70.

- The marked input voltage of –48 VDC for DC-powered routers is the nominal voltage associated with the battery circuit, and any higher voltages are only to be associated with float voltages for the charging function.

- Ensure that the polarity of the DC input wiring is correct. Under certain conditions, connections with reversed polarity might trip the primary circuit breaker or damage the equipment.

- Because the router is a positive ground system, you must connect the positive lead to the + RTN terminal, the negative lead to the –48V terminal, and the earth ground to the chassis grounding points. Use a hexagonal-head external drive socket wrench, with a minimum of 150 lb.-ins. (16 Nm) tightening torque, to connect the leads to the terminals.

- For personal safety, connect the green or green and yellow wire to safety (earth) ground at both the router and the supply side of the DC wiring.

- Terminate the DC input wiring on a DC source capable of supplying at least 70 A. Incorporate an easily accessible disconnect device into the facility wiring. Be sure to connect the ground wire or conduit to a solid office (earth) ground.

> **Note** Primary overcurrent protection is provided by the building circuit breaker. This breaker should protect against excess currents, short circuits, and earth faults in accordance with NEC ANSI/NFPA70.

DC Power Supply Warning

Warning

When stranded wiring is required, use approved wiring terminations, such as closed-loop or spade-type with upturned lugs. These terminations should be the appropriate size for the wires and should clamp both the insulation and conductor.

Waarschuwing   Wanneer geslagen bedrading vereist is, dient u bedrading te gebruiken die voorzien is van goedgekeurde aansluitingspunten, zoals het gesloten-lus type of het grijperschop type waarbij de aansluitpunten omhoog wijzen. Deze aansluitpunten dienen de juiste maat voor de draden te hebben en dienen zowel de isolatie als de geleider vast te klemmen.

Varoitus   Jos säikeellinen johdin on tarpeen, käytä hyväksyttyä johdinliitäntää, esimerkiksi suljettua silmukkaa tai kourumaista liitäntä, jossa on ylöspäin käännetyt kiinnityskorvat. Tällaisten liitäntöjen tulee olla kooltaan johtimiin sopivia ja niiden tulee puristaa yhteen sekä eristeen että johdinosan.

Attention   Quand des fils torsadés sont nécessaires, utiliser des douilles terminales homologuées telles que celles à circuit fermé ou du type à plage ouverte avec cosses rebroussées. Ces douilles terminales doivent être de la taille qui convient aux fils et doivent être refermées sur la gaine isolante et sur le conducteur.

Warnung   Wenn Litzenverdrahtung erforderlich ist, sind zugelassene Verdrahtungsabschlüsse, z.B. für einen geschlossenen Regelkreis oder gabelförmig, mit nach oben gerichteten Kabelschuhen zu verwenden. Diese Abschlüsse sollten die angemessene Größe für die Drähte haben und sowohl die Isolierung als auch den Leiter festklemmen.

Avvertenza   Quando occorre usare trecce, usare connettori omologati, come quelli a occhiello o a forcella con linguette rivolte verso l'alto. I connettori devono avere la misura adatta per il cablaggio e devono serrare sia l'isolante che il conduttore.

Advarsel   Hvis det er nødvendig med flertrådede ledninger, brukes godkjente ledningsavslutninger, som for eksempel lukket sløyfe eller spadetype med oppoverbøyde kabelsko. Disse avslutningene skal ha riktig størrelse i forhold til ledningene, og skal klemme sammen både isolasjonen og lederen.

Aviso   Quando forem requeridas montagens de instalação eléctrica de cabo torcido, use terminações de cabo aprovadas, tais como, terminações de cabo em circuito fechado e planas com terminais de orelha voltados para cima. Estas terminações de cabo deverão ser do tamanho apropriado para os respectivos cabos, e deverão prender simultaneamente o isolamento e o fio condutor.

¡Advertencia!   Cuando se necesite hilo trenzado, utilizar terminales para cables homologados, tales como las de tipo "bucle cerrado" o "espada", con las lengüetas de conexión vueltas hacia arriba. Estos terminales deberán ser del tamaño apropiado para los cables que se utilicen, y tendrán que sujetar tanto el aislante como el conductor.

Varning!   När flertrådiga ledningar krävs måste godkända ledningskontakter användas, t.ex. kabelsko av sluten eller öppen typ med uppåtvänd tapp. Storleken på dessa kontakter måste vara avpassad till ledningarna och måste kunna hålla både isoleringen och ledaren fastklämda.

DC Power Disconnection Warning

Warning

Before performing any of the following procedures, ensure that power is removed from the DC circuit. To ensure that all power is off, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the OFF position, and tape the switch handle of the circuit breaker in the OFF position.

Waarschuwing   Voordat u een van de onderstaande procedures uitvoert, dient u te controleren of de stroom naar het gelijkstroom circuit uitgeschakeld is. Om u ervan te verzekeren dat alle stroom UIT is geschakeld, kiest u op het schakelbord de stroomverbreker die het gelijkstroom circuit bedient, draait de stroomverbreker naar de UIT positie en plakt de schakelaarhendel van de stroomverbreker met plakband in de UIT positie vast.

Varoitus   Varmista, että tasavirtapiirissä ei ole virtaa ennen seuraavien toimenpiteiden suorittamista. Varmistaaksesi, että virta on KATKAISTU täysin, paikanna tasavirrasta huolehtivassa kojetaulussa sijaitseva suojakytkin, käännä suojakytkin KATKAISTU-asentoon ja teippaa suojakytkimen varsi niin, että se pysyy KATKAISTU-asennossa.

Attention   Avant de pratiquer l'une quelconque des procédures ci-dessous, vérifier que le circuit en courant continu n'est plus sous tension. Pour en être sûr, localiser le disjoncteur situé sur le panneau de service du circuit en courant continu, placer le disjoncteur en position fermée (OFF) et, à l'aide d'un ruban adhésif, bloquer la poignée du disjoncteur en position OFF.

Warnung   Vor Ausführung der folgenden Vorgänge ist sicherzustellen, daß die Gleichstromschaltung keinen Strom erhält. Um sicherzustellen, daß sämtlicher Strom abgestellt ist, machen Sie auf der Schalttafel den Unterbrecher für die Gleichstromschaltung ausfindig, stellen Sie den Unterbrecher auf AUS, und kleben Sie den Schaltergriff des Unterbrechers mit Klebeband in der AUS-Stellung fest.

Avvertenza   Prima di svolgere una qualsiasi delle procedure seguenti, verificare che il circuito CC non sia alimentato. Per verificare che tutta l'alimentazione sia scollegata (OFF), individuare l'interruttore automatico sul quadro strumenti che alimenta il circuito CC, mettere l'interruttore in posizione OFF e fissarlo con nastro adesivo in tale posizione.

Advarsel   Før noen av disse prosedyrene utføres, kontroller at strømmen er frakoblet likestrømkretsen. Sørg for at all strøm er slått AV. Dette gjøres ved å lokalisere strømbryteren på brytertavlen som betjener likestrømkretsen, slå strømbryteren AV og teipe bryterhåndtaket på strømbryteren i AV-stilling.

Aviso   Antes de executar um dos seguintes procedimentos, certifique-se que desligou a fonte de alimentação de energia do circuito de corrente contínua. Para se assegurar que toda a corrente foi DESLIGADA, localize o disjuntor no painel que serve o circuito de corrente contínua e coloque-o na posição OFF (Desligado), segurando nessa posição a manivela do interruptor do disjuntor com fita isoladora.

¡Advertencia!   Antes de proceder con los siguientes pasos, comprobar que la alimentación del circuito de corriente continua (CC) esté cortada (OFF). Para asegurarse de que toda la alimentación esté cortada (OFF), localizar el interruptor automático en el panel que alimenta al circuito de corriente continua, cambiar el interruptor automático a la posición de Apagado (OFF), y sujetar con cinta la palanca del interruptor automático en posición de Apagado (OFF).

Varning!   Innan du utför någon av följande procedurer måste du kontrollera att strömförsörjningen till likströmskretsen är bruten. Kontrollera att all strömförsörjning är BRUTEN genom att slå AV det överspänningsskydd som skyddar likströmskretsen och tejpa fast överspänningsskyddets omkopplare i FRÅN-läget.

DC Power Supply Wiring Warning

Warning Wire the DC power supply using the appropriate lugs. When connecting power, the proper wiring sequence is ground to ground, +RTN to +RTN, then -48 V to -48 V. When disconnecting power, the proper wiring sequence is -48 V to -48 V, +RTN to +RTN, then ground to ground. Note that the ground wire should always be connected first and disconnected last.

Waarschuwing De juiste bedradingsvolgorde verbonden is aarde naar aarde, +RTN naar +RTN, en –48 V naar – 48 V. De juiste bedradingsvolgorde losgemaakt is en –48 V naar – 48 V, +RTN naar +RTN, aarde naar aarde.

Varoitus Oikea yhdistettava kytkentajarjestys on maajohto maajohtoon, +RTN varten +RTN, –48 V varten – 48 V. Oikea irrotettava kytkentajarjestys on –48 V varten – 48 V, +RTN varten +RTN, maajohto maajohtoon.

Attention Câblez l'approvisionnement d'alimentation CC En utilisant les crochets appropriés à l'extrémité de câblage. En reliant la puissance, l'ordre approprié de câblage est rectifié pour rectifier, +RTN à +RTN, puis -48 V à -48 V. En débranchant la puissance, l'ordre approprié de câblage est -48 V à -48 V, +RTN à +RTN, a alors rectifié pour rectifier. Notez que le fil de masse devrait toujours être relié d'abord et débranché pour la dernière fois. Notez que le fil de masse devrait toujours être relié d'abord et débranché pour la dernière fois.

Warnung Verdrahten Sie die Gleichstrom-Versorgung mit den passenden Ansätzen am Verdrahtung Ende. Wenn man Energie anschließt, wird die korrekte Verdrahtung. Reihenfolge gerieben, um, +RTN zu +RTN, dann -48 V bis -48 V zu reiben. Wenn sie Energie trennt, ist die korrekte Verdrahtung Reihenfolge -48 V bis -48 V, +RTN zu +RTN, rieb dann, um zu reiben. Beachten Sie, daß der Erdungsdraht immer zuerst angeschlossen werden und zuletzt getrennt werden sollte. Beachten Sie, daß der Erdungsdraht immer zuerst angeschlossen werden und zuletzt getrennt werden sollte.

Avvertenza Mostra la morsettiera dell alimentatore CC. Cablare l'alimentatore CC usando i connettori adatti all'estremità del cablaggio, come illustrato. La corretta sequenza di cablaggio è da massa a massa, da positivo a positivo (da linea ad L) e da negativo a negativo (da neutro a N). Tenere presente che il filo di massa deve sempre venire collegato per primo e scollegato per ultimo.

Advarsel Riktig tilkoples tilkoplingssekvens er jord til jord, +RTN til +RTN, –48 V til – 48 V. Riktig frakoples tilkoplingssekvens er –48 V til – 48 V, +RTN til +RTN, jord til jord.

Aviso   Ate con alambre la fuente de potencia cc Usando los terminales apropiados en el extremo del cableado. Al conectar potencia, la secuencia apropiada del cableado se muele para moler, +RTN a +RTN, entonces -48 V a -48 V. Al desconectar potencia, la secuencia apropiada del cableado es -48 V a -48 V, +RTN a +RTN, entonces molió para moler. Observe que el alambre de tierra se debe conectar siempre primero y desconectar por último. Observe que el alambre de tierra se debe conectar siempre primero y desconectar por último.

¡Advertencia!   Wire a fonte de alimentação de DC Usando os talões apropriados na extremidade da fiação. Ao conectar a potência, a seqüência apropriada da fiação é moída para moer, +RTN a +RTN, então -48 V a -48 V. Ao desconectar a potência, a seqüência apropriada da fiação é -48 V a -48 V, +RTN a +RTN, moeu então para moer. Anote que o fio à terra deve sempre ser conectado primeiramente e desconectado por último. Anote que o fio à terra deve sempre ser conectado primeiramente e desconectado por último.

Varning!   Korrekt kopplingssekvens ar jord till jord, +RTN till +RTN, −48 V till − 48 V. Korrekt kopplas kopplingssekvens ar −48 V till − 48 V, +RTN till +RTN, jord till jord.

Laser Safety Guidelines

Single-mode PICs are equipped with laser transmitters, which are considered a Class 1 Laser Product by the U. S. Food and Drug Administration, and they are evaluated as a Class 1 Laser Product per EN60825 requirements.

Unterminated optical connectors can emit invisible laser radiation. The lens in the human eye focuses all the laser power on the retina, so even a low-power laser could permanently damage the eye if it is focused directly on the laser source.

When working around PICs, observe the following safety guidelines to prevent eye injury:

- Do not look into unterminated ports or at fibers that connect to unknown sources.

- Do not examine unterminated optical ports with optical instruments.

- Avoid direct exposure to the beam.

Class 1 Laser Product Warning

Class 1 laser product.

Waarschuwing   Klasse-1 laser produkt.

Varoitus   Luokan 1 lasertuote.

Attention   Produit laser de classe 1.

Warnung   Laserprodukt der Klasse 1.

Avvertenza   Prodotto laser di Classe 1.

Advarsel   Laserprodukt av klasse 1.

Aviso   Produto laser de classe 1.

¡Advertencia!   Producto láser Clase I.

Varning!   Laserprodukt av klass 1.

Laser Beam Warning

Do not stare into the laser beam or view it directly with optical instruments.

Waarschuwing   Niet in de straal staren of hem rechtstreeks bekijken met optische instrumenten.

Varoitus   Älä katso säteeseen äläkä tarkastele sitä suoraan optisen laitteen avulla.

Attention   Ne pas fixer le faisceau des yeux, ni l'observer directement à l'aide d'instruments optiques.

Warnung   Nicht direkt in den Strahl blicken und ihn nicht direkt mit optischen Geräten prüfen.

Avvertenza   Non fissare il raggio con gli occhi né usare strumenti ottici per osservarlo direttamente.

Advarsel   Stirr eller se ikke direkte p strlen med optiske instrumenter.

Aviso   Não olhe fixamente para o raio, nem olhe para ele directamente com instrumentos ópticos.

¡Advertencia!   No mirar fijamente el haz ni observarlo directamente con instrumentos ópticos.

Varning!   Rikta inte blicken in mot strålen och titta inte direkt på den genom optiska instrument.

Radiation from Open Port Apertures

Warning

Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures.

Waarschuwing   Aangezien onzichtbare straling vanuit de opening van de poort kan komen als er geen fiberkabel aangesloten is, dient blootstelling aan straling en het kijken in open openingen vermeden te worden.

Varoitus   Koska portin aukosta voi emittoitua näkymätöntä säteilyä, kun kuitukaapelia ei ole kytkettynä, vältä säteilylle altistumista äläkä katso avoimiin aukkoihin.

Attention   Des radiations invisibles à l'il nu pouvant traverser l'ouverture du port lorsqu'aucun câble en fibre optique n'y est connecté, il est recommandé de ne pas regarder fixement l'intérieur de ces ouvertures.

Warnung   Warnung: Aus der Port-Öffnung können unsichtbare Strahlen emittieren, wenn kein Glasfaserkabel angeschlossen ist. Vermeiden Sie es, sich den Strahlungen auszusetzen, und starren Sie nicht in die Öffnungen!

Avvertenza   Quando i cavi in fibra non sono inseriti, radiazioni invisibili possono essere emesse attraverso l'apertura della porta. Evitate di esporvi alle radiazioni e non guardate direttamente nelle aperture.

Advarsel   Unngå utsettelse for stråling, og stirr ikke inn i åpninger som er åpne, fordi usynlig stråling kan emiteres fra portens åpning når det ikke er tilkoblet en fiberkabel.

Aviso   Dada a possibilidade de emissão de radiação invisível através do orifício da via de acesso, quando esta não tiver nenhum cabo de fibra conectado, deverá evitar a exposição à radiação e não deverá olhar fixamente para orifícios que se encontrarem a descoberto.

¡Advertencia!   Debido a que la apertura del puerto puede emitir radiación invisible cuando no existe un cable de fibra conectado, evite mirar directamente a las aperturas para no exponerse a la radiación.

Varning!   Osynlig strålning kan avges från en portöppning utan ansluten fiberkabel och du bör därför undvika att bli utsatt för strålning genom att inte stirra in i oskyddade öppningar.

Class 1 LED Product Warning

Class 1 LED product

Waarschuwing Klasse 1 LED-product

Varoitus Luokan 1 valodioituote

Attention Alarme de produit LED Class I

Warnung Class 1 LED-Produktwarnung

Avvertenza Avvertenza prodotto LED di Classe 1

Advarsel LED-produkt i klasse 1

Aviso Produto de classe 1 com LED

¡Advertencia! Aviso sobre producto LED de Clase 1

Varning! Lysdiodprodukt av klass 1

Product Disposal Warning

Disposal of this product must be handled according to all national laws and regulations.

Waarschuwing Dit produkt dient volgens alle landelijke wetten en voorschriften te worden afgedankt.

Varoitus Tämän tuotteen lopullisesta hävittämisestä tulee huolehtia kaikkia valtakunnallisia lakeja ja säännöksiä noudattaen.

Attention La mise au rebut définitive de ce produit doit être effectuée conformément à toutes les lois et réglementations en vigueur.

Warnung Dieses Produkt muß den geltenden Gesetzen und Vorschriften entsprechend entsorgt werden.

Avvertenza L'eliminazione finale di questo prodotto deve essere eseguita osservando le normative italiane vigenti in materia.

Advarsel Endelig disponering av dette produktet må skje i henhold til nasjonale lover og forskrifter.

Aviso A descartagem final deste produto deverá ser efectuada de acordo com os regulamentos e a legislação nacional.

¡Advertencia! El desecho final de este producto debe realizarse según todas las leyes y regulaciones nacionales.

Varning! Slutlig kassering av denna produkt bör skötas i enlighet med landets alla lagar och föreskrifter.

Lightning Activity Warning

Warning

Do not work on the system or connect or disconnect cables during periods of lightning activity.

Waarschuwing   Tijdens onweer dat gepaard gaat met bliksem, dient u niet aan het systeem te werken of kabels aan te sluiten of te ontkoppelen.

Varoitus   Älä työskentele järjestelmän parissa äläkä yhdistä tai irrota kaapeleita ukkosilmalla.

Attention   Ne pas travailler sur le système ni brancher ou débrancher les câbles pendant un orage.

Warnung   Arbeiten Sie nicht am System und schließen Sie keine Kabel an bzw. trennen Sie keine ab, wenn es gewittert.

Avvertenza   Non lavorare sul sistema o collegare oppure scollegare i cavi durante un temporale con fulmini.

Advarsel   Utfør aldri arbeid på systemet, eller koble kabler til eller fra systemet når det tordner eller lyner.

Aviso   Não trabalhe no sistema ou ligue e desligue cabos durante períodos de mau tempo (trovoada).

¡Advertencia!   No operar el sistema ni conectar o desconectar cables durante el transcurso de descargas eléctricas en la atmósfera.

Varning!   Vid åska skall du aldrig utföra arbete på systemet eller ansluta eller koppla loss kablar.

Jewelry Removal Warning

Warning

Before working on equipment that is connected to power lines, remove jewelry, including rings, necklaces, and watches. Metal objects heat up when connected to power and ground and can cause serious burns or become welded to the terminals.

Waarschuwing Alvorens aan apparatuur te werken die met elektrische leidingen is verbonden, sieraden (inclusief ringen, kettingen en horloges) verwijderen. Metalen voorwerpen worden warm wanneer ze met stroom en aarde zijn verbonden, en kunnen ernstige brandwonden veroorzaken of het metalen voorwerp aan de aansluitklemmen lassen.

Varoitus Ennen kuin työskentelet voimavirtajohtoihin kytkettyjen laitteiden parissa, ota pois kaikki korut (sormukset, kaulakorut ja kellot mukaan lukien). Metalliesineet kuumenevat, kun ne ovat yhteydessä sähkövirran ja maan kanssa, ja ne voivat aiheuttaa vakavia palovammoja tai hitsata metalliesineet kiinni liitäntänapoihin.

Attention Avant d'accéder à cet équipement connecté aux lignes électriques, ôter tout bijou (anneaux, colliers et montres compris). Lorsqu'ils sont branchés à l'alimentation et reliés à la terre, les objets métalliques chauffent, ce qui peut provoquer des blessures graves ou souder l'objet métallique aux bornes.

Warnung Vor der Arbeit an Geräten, die an das Netz angeschlossen sind, jeglichen Schmuck (einschließlich Ringe, Ketten und Uhren) abnehmen. Metallgegenstände erhitzen sich, wenn sie an das Netz und die Erde angeschlossen werden, und können schwere Verbrennungen verursachen oder an die Anschlußklemmen angeschweißt werden.

Avvertenza Prima di intervenire su apparecchiature collegate alle linee di alimentazione, togliersi qualsiasi monile (inclusi anelli, collane, braccialetti ed orologi). Gli oggetti metallici si riscaldano quando sono collegati tra punti di alimentazione e massa: possono causare ustioni gravi oppure il metallo può saldarsi ai terminali.

Advarsel Fjern alle smykker (inkludert ringer, halskjeder og klokker) før du skal arbeide på utstyr som er koblet til kraftledninger. Metallgjenstander som er koblet til kraftledninger og jord blir svært varme og kan forårsake alvorlige brannskader eller smelte fast til polene.

Aviso Antes de trabalhar em equipamento que esteja ligado a linhas de corrente, retire todas as jóias que estiver a usar (incluindo anéis, fios e relógios). Os objectos metálicos aquecerão em contacto com a corrente e em contacto com a ligação à terra, podendo causar queimaduras graves ou ficarem soldados aos terminais.

¡Advertencia! Antes de operar sobre equipos conectados a líneas de alimentación, quitarse las joyas (incluidos anillos, collares y relojes). Los objetos de metal se calientan cuando se conectan a la alimentación y a tierra, lo que puede ocasionar quemaduras graves o que los objetos metálicos queden soldados a los bornes.

Varning! Tag av alla smycken (inklusive ringar, halsband och armbandsur) innan du arbetar på utrustning som är kopplad till kraftledningar. Metallobjekt hettas upp när de kopplas ihop med ström och jord och kan förorsaka allvarliga brännskador; metallobjekt kan också sammansvetsas med kontakterna.

TN and IT Power Warning

Warning

The router is designed to work with TN, IT power systems.

Waarschuwing   Het apparaat is ontworpen om te functioneren met TN, IT energiesystemen.

Varoitus   Koje on suunniteltu toimimaan TN-, IT-sähkövoimajärjestelmien yhteydessä.

Attention   Ce dispositif a été conçu pour fonctionner avec des systèmes d'alimentation TN.

Warnung   Das Gerät ist für die Verwendung mit TN-, IT-Stromsystemen ausgelegt.

Avvertenza   Il dispositivo è stato progettato per l'uso con sistemi di alimentazione TN, IT.

Advarsel   Utstyret er utfomet til bruk med TN-, IT-strømsystemer.

Aviso   O dispositivo foi criado para operar com sistemas de corrente TN, IT.

¡Advertencia!   El equipo está diseñado para trabajar con sistemas de alimentación tipo TN, IT.

Varning!   Enheten är konstruerad för användning tillsammans med elkraftssystem av TN-, IT-typ.

Battery Handling Warning

Warning

Replacing the battery incorrectly might result in an explosion. Replace the battery only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

Waarschuwing   Er is ontploffingsgevaar als de batterij verkeerd vervangen wordt. Vervang de batterij slechts met hetzelfde of een equivalent type dat door de fabrikant aanbevolen is. Gebruikte batterijen dienen overeenkomstig fabrieksvoorschriften weggeworpen te worden.

Varoitus   Räjähdyksen vaara, jos akku on vaihdettu väärään akkuun. Käytä vaihtamiseen ainoastaan saman- tai vastaavantyyppistä akkua, joka on valmistajan suosittelema. Hävitä käytetyt akut valmistajan ohjeiden mukaan.

Attention   Danger d'explosion si la pile n'est pas remplacée correctement. Ne la remplacer que par une pile de type semblable ou équivalent, recommandée par le fabricant. Jeter les piles usagées conformément aux instructions du fabricant.

Warnung   Bei Einsetzen einer falschen Batterie besteht Explosionsgefahr. Ersetzen Sie die Batterie nur durch den gleichen oder vom Hersteller empfohlenen Batterietyp. Entsorgen Sie die benutzten Batterien nach den Anweisungen des Herstellers.

Avvertenza   Pericolo di esplosione se la batteria non è installata correttamente. Sostituire solo con una di tipo uguale o equivalente, consigliata dal produttore. Eliminare le batterie usate secondo le istruzioni del produttore.

Advarsel   Det kan være fare for eksplosjon hvis batteriet skiftes på feil måte. Skift kun med samme eller tilsvarende type som er anbefalt av produsenten. Kasser brukte batterier i henhold til produsentens instruksjoner.

Aviso   Existe perigo de explosão se a bateria for substituída incorrectamente. Substitua a bateria por uma bateria igual ou de um tipo equivalente recomendado pelo fabricante. Destrua as baterias usadas conforme as instruções do fabricante.

¡Advertencia!   Existe peligro de explosión si la batería se reemplaza de manera incorrecta. Reemplazar la batería exclusivamente con el mismo tipo o el equivalente recomendado por el fabricante. Desechar las baterías gastadas según las instrucciones del fabricante.

Varning!   Explosionsfara vid felaktigt batteribyte. Ersätt endast batteriet med samma batterityp som rekommenderas av tillverkaren eller motsvarande. Följ tillverkarens anvisningar vid kassering av använda batterier.

Agency Approvals

The router is designed to comply with the following regulatory standards:

- Safety

  - CSA 22.2-No.950/UL 1950 Third Edition - Safety of Information Technology Equipment, Including Electrical Business Equipment

  - EN 60950 Safety of Information Technology Equipment

  - EN 60825-1 Safety of Laser Products - Part 1: Equipment Classification, Requirements and User's Guide

- EN 60825-2 Safety of Laser Products - Part 2: Safety of Optical Fibre Communication Systems

- UL 1950

■ EMI

- AS 3548 Class A

- BSMI Class A

- EN 55022 Class A

- FCC Class A

- VCCI Class 1

■ Immunity

- EN-61000-3-2 Power Line Harmonics

- EN-61000-4-2 ESD

- EN-61000-4-3 Radiated Immunity

- EN-61000-4-4 EFT

- EN-61000-4-5 Surge

- EN-61000-4-6 Low Frequency Common Immunity

- EN-61000-4-11 Voltage Dips and Sags

■ NEBS—The router is designed to meet the following NEBS standards:

- SR-3580 NEBS Criteria Levels (Level 3 compliance)

- GR-63-Core Physical Protection

- GR-1089-Core EMC and Safety

■ ETSI

- ETS-300386-2 Switching Equipment

Compliance Statements for EMC Requirements

Canada

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

European Community

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Japan

この装置は、クラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。　　　　　　VCCI-A

The above translates as:

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.
VCCI-A

Taiwan

警告使用者:
這是甲類的資訊產品, 在居住的環境中使用時, 可能會造成射頻干擾, 在這種情況下, 使用者會被要求採取某些適當的對策.

United States

The router has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Chapter 7
Prepare to Install the Router

After you have prepared your installation site as described in the chapter "Prepare the Site" on page 39, you are ready to begin unpacking and installing the router. It is important to proceed through the installation in the following order:

1. Review safety guidelines as explained in the chapter "Regulatory Compliance and Safety Information" on page 57.

2. Follow the instructions in this chapter to unpack the router and verify the parts received.

3. Install the router in the rack, as explained in the chapter "Install the Router and Perform Initial Software Configuration" on page 97.

This chapter describes how to prepare to install the router. It discusses the following topics:

- Tools Required on page 91

- General Safety Warnings and Guidelines on page 92

- Prevent ESD Damage on page 93

- Unpack the Router on page 94

- Verify Parts Received on page 96

Tools Required

To unpack and install the router, you need the following tools:

- Phillips (+) screwdrivers, numbers 1 and 2

- Flat-blade (–) screwdrivers, 3/16-in. and 1/4-in.

- Electrostatic bags, one for each Flexible PIC Concentrator (FPC)

- 9/16-in. or 14-mm open-end or socket wrench to remove bracket bolts from the shipping pallet

- Antistatic mat, placed on a flat, stable surface

- Electrostatic discharge (ESD) grounding wrist strap

General Safety Warnings and Guidelines

To safely install the router, you must understand the safety warnings and follow proper safety guidelines. This section discusses the various warnings and guidelines associated with installing the router:

■ General Safety Warnings on page 92

■ General Safety Guidelines on page 92

> **Note**
> For a complete list of safety warnings and guidelines, see "Regulatory Compliance and Safety Information" on page 57.

General Safety Warnings

The following notes indicate two levels of precautionary guidelines:

> **Warning**
> Failure to observe the guidelines in a warning note could result in serious physical injury.

> **Caution**
> Failure to observe guidelines included in a cautionary note could result in minor injury, discomfort to you, or severe damage to the router.

General Safety Guidelines

To ensure your safety, always follow all instructions and warnings marked on the router, router components, and accessories. The following are general safety guidelines that you should follow when installing and using the router:

■ Perform only those system services that are explicitly described in this installation guide. Make sure that only authorized service personnel perform other system services.

■ For protection against shock hazard, verify that all power cables are disconnected before servicing the unit.

■ Never install wiring during electrical storms.

■ Never install electrical jacks in wet locations unless the jacks are specifically designed for wet environments.

■ Operate the router only when the grounding wire is connected.

- Do not open or remove chassis covers or sheet metal parts when instructions are not provided in this manual. Such an action could cause severe electrical shock.

- Do not push or force any objects through any of the openings in the chassis frame. Such an action could result in electrical shock or fire.

- Avoid spilling liquid onto the router chassis or onto any router component. Such an action could cause electrical shock or damage the router.

- Avoid touching uninsulated electrical wires or terminals that have not been disconnected from their power source. Such an action could cause electrical shock.

Prevent ESD Damage

Many router hardware components are sensitive to damage from static electricity. Some components can be impaired by as little as 30 V. You can easily generate potentially damaging static voltages when you handle plastic or foam packing material or if you move components across plastic or carpet. To prevent intermittent or complete component failures, always take ESD precautions.

To minimize the potential for ESD damage, observe the following guidelines:

- Always use an ESD wrist strap or ankle strap, and make sure that it is in direct contact with your skin.

> ⚠ **Caution**   For equipment safety, periodically check the resistance value of the antistatic strap. The measurement should range from 1 to 10 Mohms.
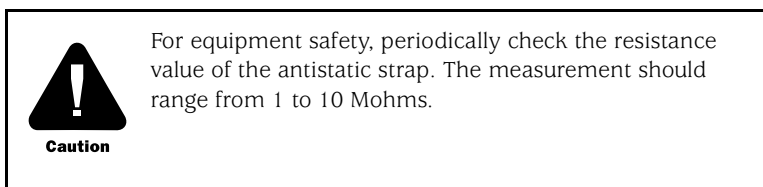
- When handling a removed FPC, PIC, or other board, make sure the equipment-end of your ESD strap is attached to one of the electrostatic discharge points on the chassis.

- Avoid contact between the board and your clothing. ESD emitted from clothing can damage components.

- When removing or installing a board, always place it component-side up on an antistatic surface, in an antistatic card rack, or in an electrostatic bag (see Figure 29). If you are returning the board to the factory, immediately store the board in an electrostatic bag.

Figure 29: Place a Board Component into an Electrostatic Bag

CAUTION
ELECTROSTATIC
SENSITIVE
DEVICES

DO NOT OPEN OR HANDLE
EXCEPT AT A
STATIC-FREE WORKSTATION
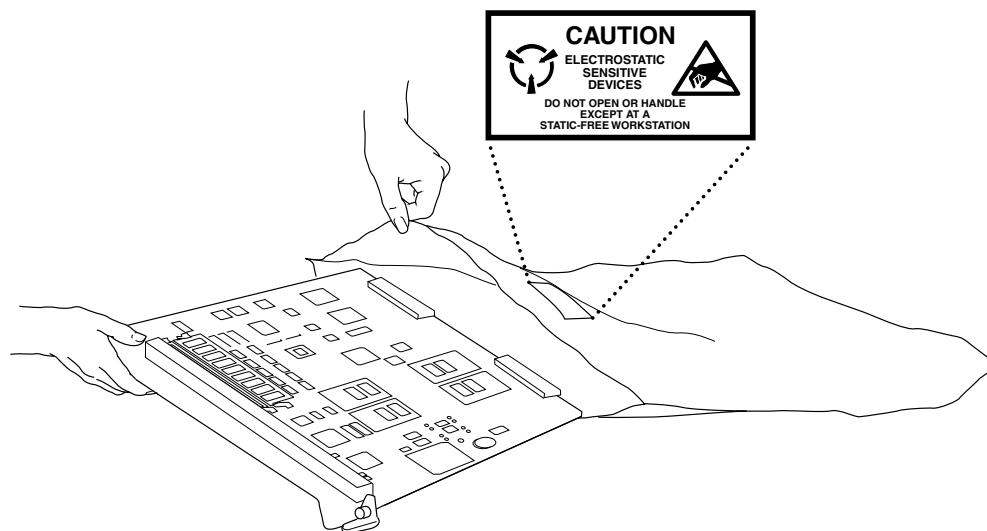
1051

Unpack the Router

The router is shipped in a wooden crate (see Figure 30). A wooden pallet forms the bottom of the wooden crate. The router chassis is bolted to this pallet. A cardboard accessory box is also included in the shipping crate.

> Because the router is protected inside its shipping box, we recommend that you not unpack it until you are ready to install it.
>
> **Note**

To unpack the system, follow these steps:

1. Move the shipping box to a staging area as close to the installation site as possible, where you have enough room to remove the router components. While the chassis is bolted to the pallet, you can use a forklift to move the chassis.

2. Position the shipping crate so that the arrows are pointing up.

3. Lift the shipping crate cover off the bottom pallet.

4. Remove the accessory box, which is located on top of the router.

Figure 30: Contents of the Shipping Carton

Shipping crate
cover

M20 Chassis

Shipping
restraints

Shipping crate
base

1252
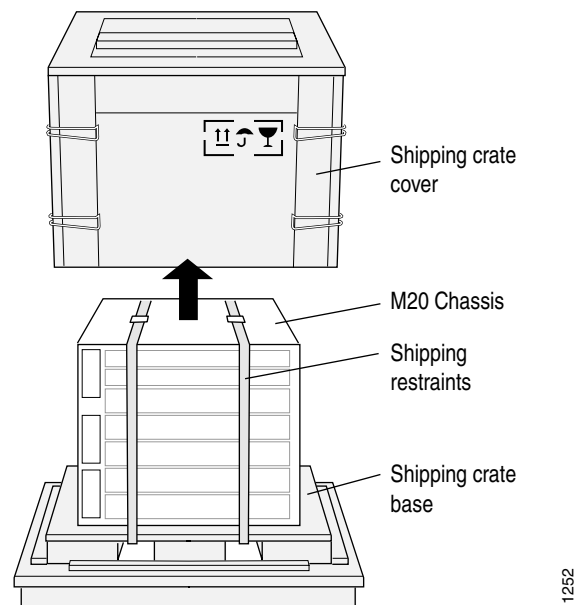
5. Examine the accessory box and verify the parts received against the parts list in Table 23.

6. Undo the shipping restraints, holding the router in place.

7. Unbolt the chassis from the pallet using a 9/16-in. or 14 mm socket wrench to remove the bolts from the brackets that attach the chassis to the pallet. Store the brackets and lugs inside the accessory box.

8. To proceed with the installation, refer to the chapter "Install the Router and Perform Initial Software Configuration" on page 97.

> Save the shipping carton, box, packing materials, and pallet in case you need to move or ship the router at a later time.
>
> **Note**

Verify Parts Received

A packing list included in each shipment specifies the part numbers and descriptions of each part in your order. Verify the parts you received against the items in the packing list. In general, each router is shipped fully configured.

If any part is missing, contact a customer service representative.

The shipment contains the chassis, which consists of the parts listed in Table 22 (all components are installed) and an accessory box, which contains the parts listed in Table 23.

Table 22: Router Parts List

Component	Quantity Shipped
Routing Engine	2
Power supplies with integrated fans	2
FPCs preconfigured with up to 4 PICs each	Up to 4; slots without FPCs contain FPC blanks
PICs	Up to 4 per FPC
SSB	1
Midplane	1
Front Fan Trays	3
Rear Fan Tray	1

Table 23: Accessories Box Parts List

Part Description	Quantity Shipped
ESD wrist strap and cable	1
DC power cable lugs and bolts (if you ordered DC supplies)	2
AC power cables (if you ordered AC supplies)	2
Front-mounting brackets	2
PC card containing a copy of the JUNOS Internet software	1
Software license agreement	1
Serial cable to link Routing Engine to management console	1
Ethernet cable, 15-ft length with RJ-45/RJ-45 connectors	1
DB-9/DB-25 adapter	1
Read-me first document	1
Hardware release notes	1
Software release notes	1
M20 Internet Router Hardware Guide (this manual)	1
CD-ROM containing documentation	1

Chapter 8
Install the Router and Perform Initial Software Configuration

Before installing the chassis, you should have prepared your site and reviewed the guidelines given in the chapter "Prepare the Site" on page 39, and unpacked the system from the shipping carton, as described in the section "Unpack the Router" on page 94.

Because a fully configured router weighs approximately 134 lb (61 kg), you must remove some of the components before installing the router. If you plan to use a mechanical lift to install the chassis in the rack, you do not need to remove the system components from the chassis first.

This chapter describes how to install the router and discusses the following topics:

- Tools and Parts Required on page 97

- Remove Components from the Chassis on page 98

- Reinstall Components into the Chassis on page 109

- Power Up the Router on page 126

- Perform Initial Software Configuration on page 126

Tools and Parts Required

You need the following tools and parts to install the chassis and its components:

- Philips (+) screwdrivers, numbers 1 and 2

- Flat-blade (–) screwdrivers, 3/16-in. and 1/4-in.

- Electrostatic bags, one for each Flexible PIC Concentrator (FPC) removed

- Antistatic mat, placed on a flat, stable surface

- Electrostatic discard grounding wrist strap

- Wire cutters

- Pliers

Remove Components from the Chassis

If you plan to lift the chassis into the rack manually, you must remove enough of the system components so that two people can safely lift the chassis. After removing the components, the chassis weighs approximately 80 lb (36 kg). The heaviest components are the power supplies. The following procedures describe how to remove components from the chassis:

- Remove the DC Power Supplies on page 99, or Remove the AC Power Supplies on page 100

- Remove the Routing Engine on page 101

- Remove the Rear Fan Tray on page 102

- Remove the Front Fan Trays on page 103

- Remove the FPCs on page 104

- Remove the SSB on page 106

- Remove the Craft Interface on page 107

> **Note**
>
> The procedures in the following sections apply only to the initial installation of your router. It is assumed that you have not connected power to the router. If you are installing or replacing components when your router is operational, refer to the appropriate maintenance chapters.

Table 24 summarizes the weight of the chassis components.

Table 24: Chassis Component Weights

Component	Approximate Weight (lb)	Approximate Weight (kg)
Power supply	12	5.5
Routing Engine	3	1.5
Front fan tray	5	2
Rear fan tray	2	1
Cable management system	2	1
FPC configured with 4 PICs	3	1
System and Switch Board (SSB)	3	1.5

Remove the DC Power Supplies

The DC power supplies are located at the lower rear of the chassis. Each DC power supply weighs approximately 12 lb (5.5 kg).

To remove each of the DC power supplies, follow this procedure:

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Locate the power switch and flip it to the **OFF** position (see Figure 31).

Figure 31: Flip the DC Power Switch Off
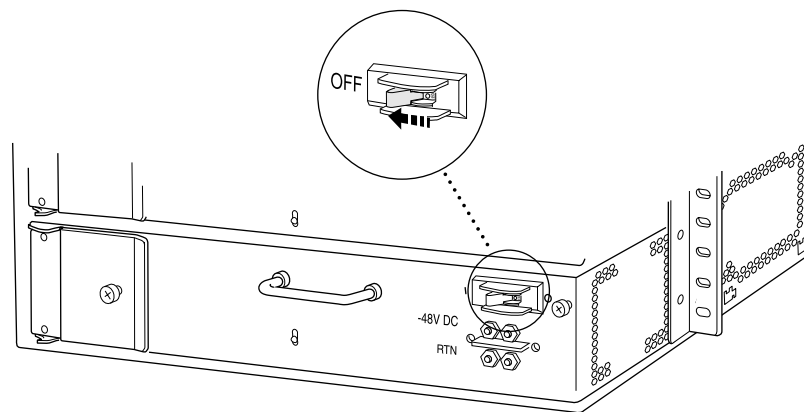
3. Undo the two thumbscrews attached to the power supply (one on the ejector handle and one on the opposite side) (see Figure 32) and pull back on the ejector handle. Turn the right screw a few rotations and then turn the left screw a few rotations to disengage the power supply from the midplane in a uniform manner.

> You will probably need a screwdriver to loosen the thumbscrews.
>
> **Note**

Figure 32: Remove a DC Power Supply
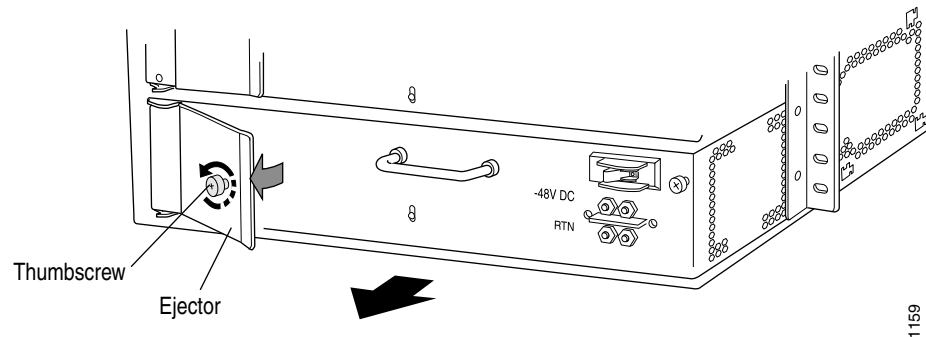
Thumbscrew

Ejector

1159

4. Grasp the handle on the power supply faceplate with one hand. Slide the power supply about three quarters of the way out of the power supply bay.

5. Place your other hand underneath the power supply to support its weight and remove it from the chassis.

6. Repeat Steps 2 through 5 to remove the second power supply.

Remove the AC Power Supplies

The AC power supplies are located at the bottom rear of the chassis. Each AC power supply weighs approximately 12 lb (5.5 kg).

To remove each of the AC supplies, follow this procedure (see Figure 33):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Locate the power switch and flip it to the **OFF** position.

3. Undo the two thumbscrews attached to the power supply (one on the ejector handle and one on the opposite side), and pull back on the ejector handle. Turn the right screw a few rotations and then turn the left side screw a few rotations to disengage the power supply from the midplane in a uniform manner.

> You will probably need a screwdriver to loosen the thumbscrews.
>
> **Note**

4. Grasp the handle on the power supply faceplate with one hand. Slide the power supply about three quarters of the way out of the power supply bay.

5. Place your other hand underneath the power supply to support its weight and remove it from the chassis.

6. Repeat Steps 2 through 5 to remove the second power supply.

Figure 33: Remove an AC Power Supply

Thumbscrew

Ejector

1139

Remove the Routing Engine

The Routing Engine is located at the rear of the chassis above the power supplies. The Routing Engine weighs approximately 3 lb (1.2 kg).

To remove the Routing Engine, follow this procedure (see Figure 34):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Unscrew the thumbscrews on the left and right sides of the Routing Engine to unseat the Routing Engine from the midplane.

3. Flip the ends of the two extractor clips, which are adjacent to the thumbscrews, towards the outside edges of the router.

4. Grasp both sides of the Routing Engine and slide it about three quarters of the way out of the router.

> ⚠ **Caution**   When removing the Routing Engine, slide the unit out evenly. If you pull one side out faster than the other side, the unit might get lodged in the rail and become damaged.

5. Move one of your hands underneath the housing to support it, and slide the Routing Engine completely out of the chassis.

Figure 34: Remove the Routing Engine

Rear Routing
Engine panel

Routing Engine

Ejectors

1117

Remove the Rear Fan Tray

The rear fan tray is located at the top right side of the rear of the chassis above the power supplies. The rear fan tray weighs approximately 2 lb (1 kg).

To remove the rear fan tray, follow this procedure (see Figure 35):

1.   Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2.   Loosen the two thumbscrews at the right side of the tray.

> You will probably need a screwdriver to loosen the thumbscrews.
>
> **Note**

3.   Pulling on the small handle, slide the rear fan tray out of the chassis.

Figure 35: Remove the Rear Fan Tray
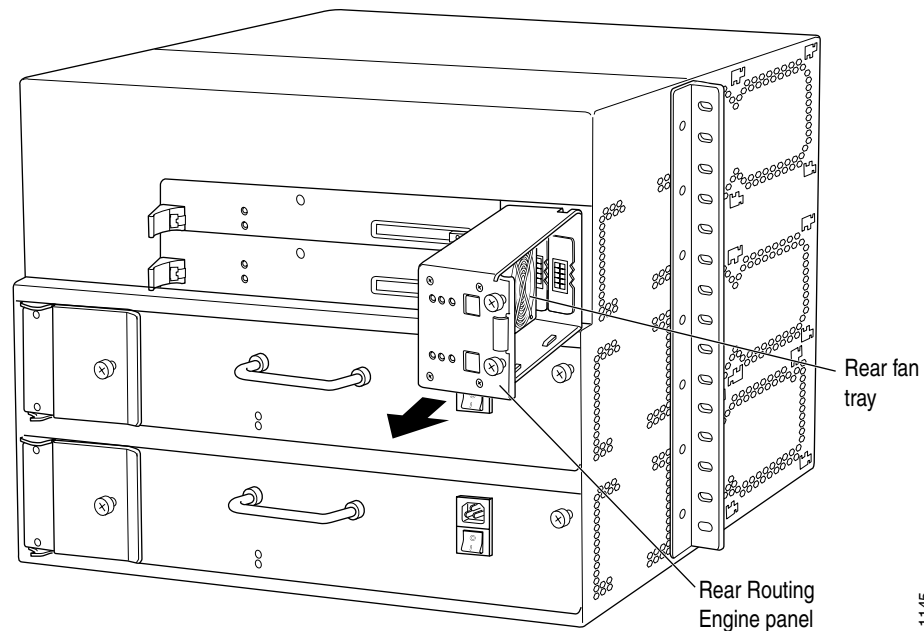
Remove the Front Fan Trays

The three front fan trays are located at the front left of the chassis. Each fan tray, which houses three separate fan assemblies, weighs approximately 5 lb (2 kg).

To remove the fan tray, follow this procedure (see Figure 36):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Unscrew the thumbscrew near the middle of the fan tray.

3. Grasp the fan tray handle and slide the tray three quarters of the way out of the chassis.

4. Move one of your hands underneath the fan tray to support it and slide the fan tray completely out of the chassis.

5. Repeat Steps 2 through 4 to remove the remaining two front fan trays.

Figure 36: Remove a Front Fan Tray
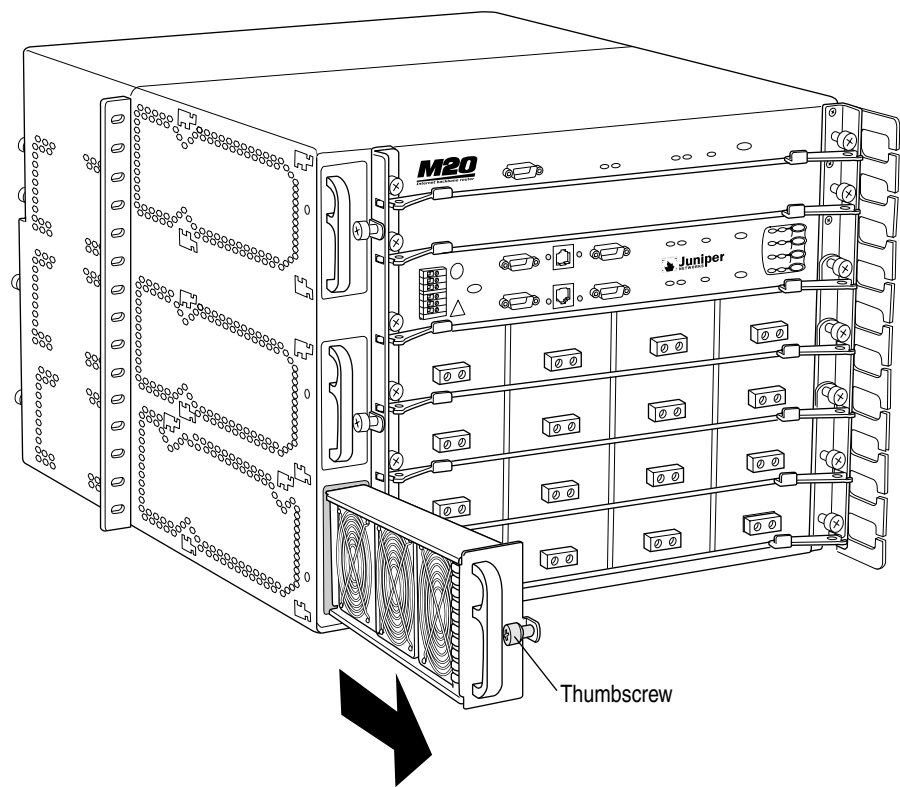
Thumbscrew

1118

Remove the FPCs

The FPCs are located on the front of the chassis below the craft interface. Each FPC, fully configured with four PICs, weighs about 3 lb (1.5 kg).

> **Note**
> You can remove FPCs in any order. For purposes of organization, the following procedure arbitrarily directs you to remove FPCs starting at the top of the chassis and moves down. Whatever order you use, you should label each FPC with its slot number as you remove it (see Table 25) so you know where to replace it.

Table 25: FPC Removal Checklist

Slot	Media Type	Removed	Reinstalled
0			
1			
2			
3			

To remove the FPCs, follow this procedure (see Figure 37):

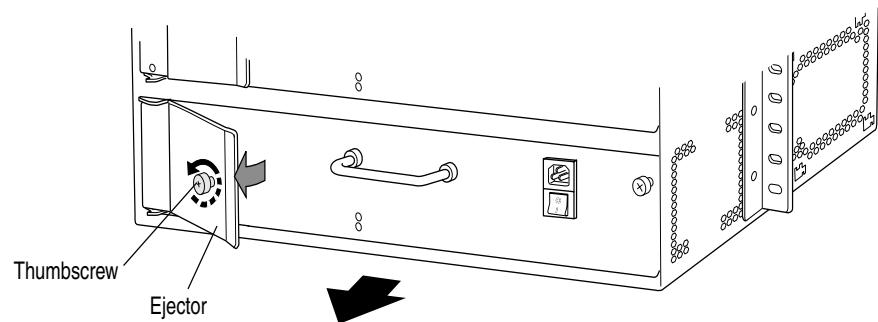1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Locate the FPC immediately below the craft interface. This FPC is labeled FPC0. The label is stamped on the chassis to the right of the FPC.

3. Unscrew the thumbscrews on the left and right sides of the card carrier to unseat the FPC from the midplane.

4. Flip the ends of the two extractor clips, which are adjacent to the thumbscrews, towards the outside edges of the router.

5. Grasp both sides of the card carrier and slide the FPC about three quarters of the way out of the router.

6. Move one of your hands underneath the FPC to support it, and slide it completely out of the chassis.

Figure 37: Remove an FPC
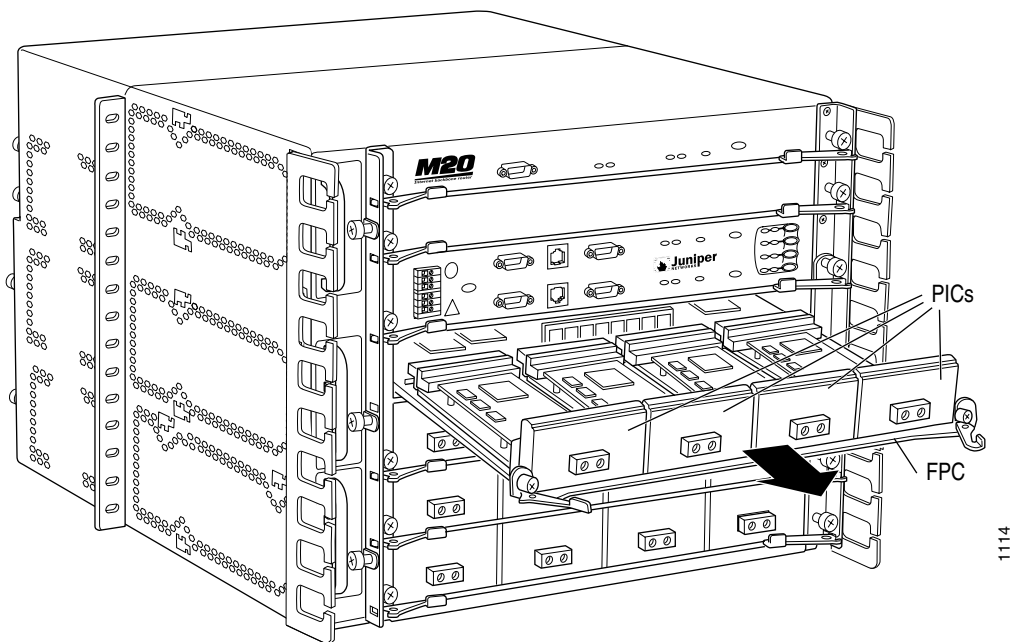
7. Moving from top to bottom, repeat Steps 3 through 6 to remove the remaining three FPCs from the chassis.

Remove the SSB

The SSB is located at the center front of the card cage. It weighs approximately 3 lb (1.5 kg).
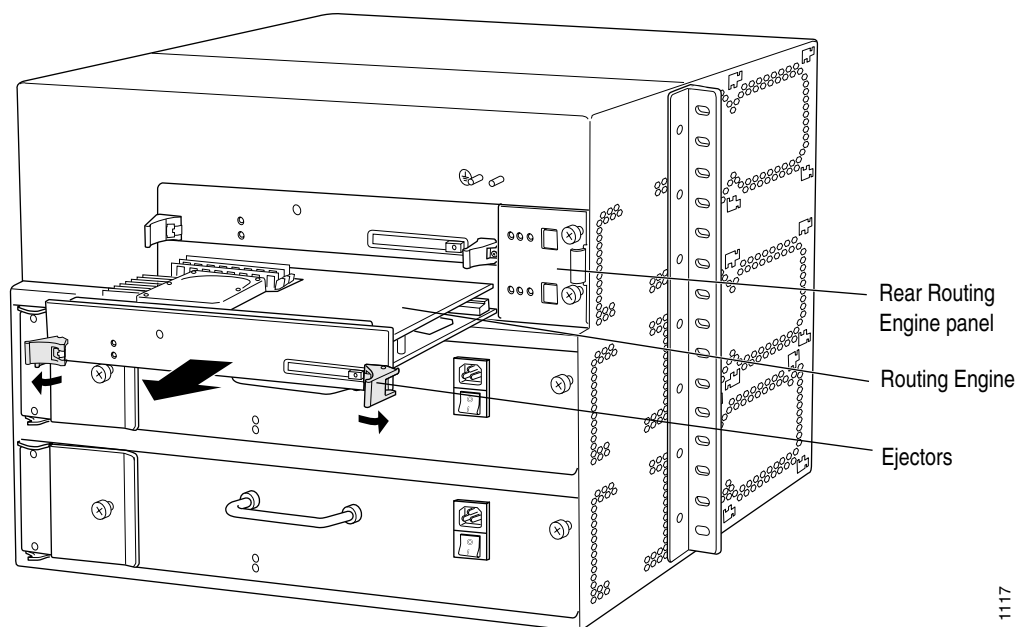
To remove the SSB, follow this procedure (see Figure 38):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Locate the SSB offline switch on the front panel and press and hold down the switch for five seconds to take the SSB offline.

> ⚠ **Caution**
>
> If you do not take the SSB offline before removing it, you might lose data.

3. Unscrew the thumbscrews on the left and right sides of the card carrier to unseat the SSB from the midplane.

4. Flip the ends of the two extractor clips, which are adjacent to the thumbscrews, towards the outside edges of the router.

5. Grasp both sides of the card carrier and slide the SSB about three quarters of the way out of the router.

6. Move one of your hands underneath the SSB to support it, and slide it completely out of the chassis.

Figure 38: Remove the SSB
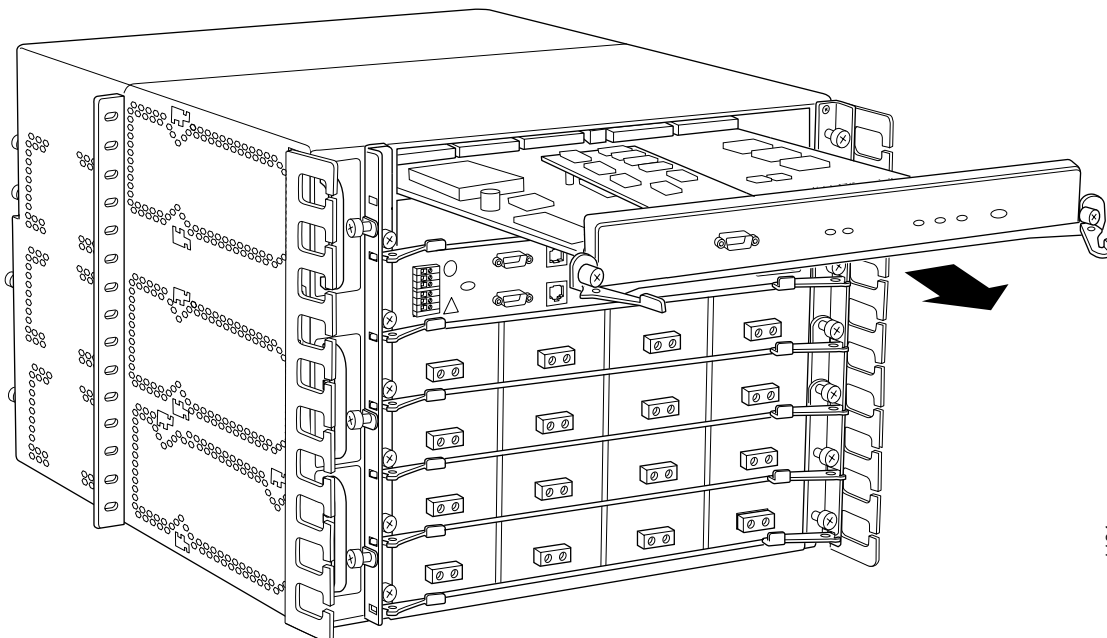
1124

Remove the Craft Interface

The craft interface is located at the center front of the card cage. It weighs approximately 3 lb (1.5 kg).

To remove the craft interface, follow this procedure (see Figure 39):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Locate the craft interface offline switch on the front panel and press and hold down the swich for five seconds to take the craft interface offline.

3. Unscrew the thumbscrews on the left and right sides of the card carrier to unseat the craft interface from the midplane.

4. Flip the ends of the two extractor clips, which are adjacent to the thumbscrews, towards the outside edges of the router.

5. Grasp both sides of the card carrier and slide the craft interface about three quarters of the way out of the router.

6. Move one of your hands underneath the craft interface to support it, and slide it completely out of the chassis.

Figure 39: Remove the Craft Interface
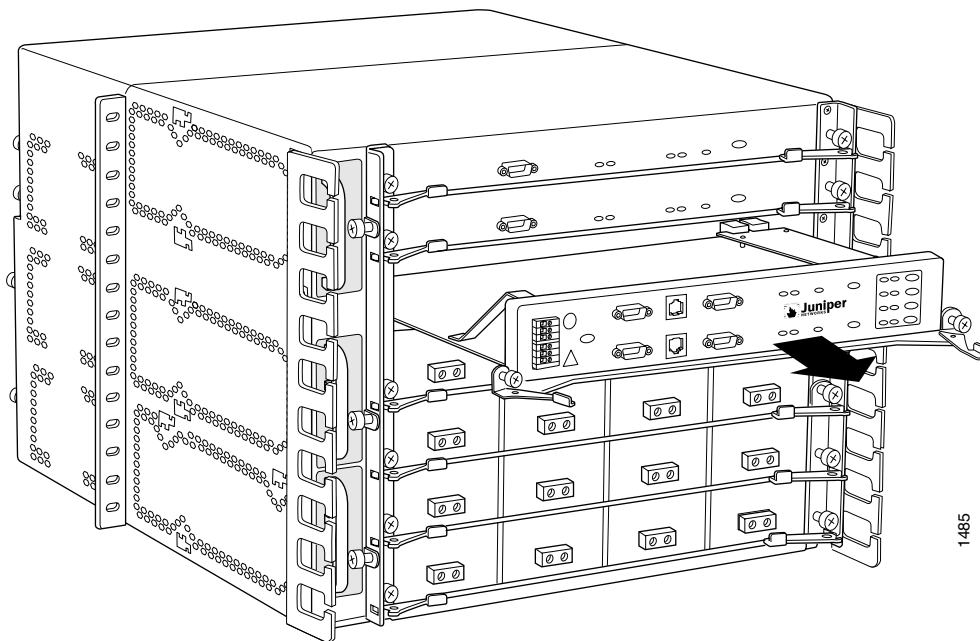
Install the Chassis into the Rack

> ⚡ **Warning**
>
> Two people are required to lift the chassis and mount it into a rack. A minimally configured chassis weighs approximately 80 lb (36 kg). Unless you are using a mechanical lift, do not attempt to load the chassis into the rack without removing the heaviest components first, as described in the section, "Remove Components from the Chassis" on page 98. Failure to do so could result in personal injury or damage to the router.

To install the chassis into the rack, follow this procedure (see Figure 40):

1. Make sure that the rack is installed in its permanent location and is secured to the building, and that you have allowed adequate clearance for both air flow and maintenance. For more information, see the chapter "Prepare the Site" on page 39.

2. With one person at the front and one at the back of the chassis, grasp the front and side of the chassis, lift the chassis, and position it in the rack.

3. Starting at the bottom of the rack, align one of the rack's mounting holes with the bottom mounting hole in the chassis rack-mounting rail.

4. Level the chassis so that the same mounting hole on the other chassis rack-mounting rail is aligned with a hole in the rack.

5. From the front of the rack, install a mounting screw into each of the two aligned holes.

6. Moving up the chassis rack-mounting rail, install mounting screws in every mounting hole on the rail until you reach the top.

Figure 40: Install the Chassis in a Rack
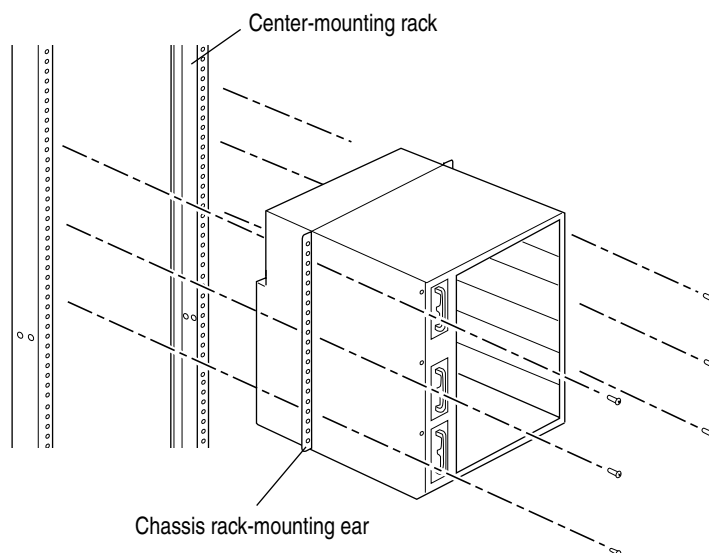
1125

Verify That the Chassis Is Installed Correctly

If the chassis is installed properly in the rack, all the mounting screws on one side of the rack should be aligned with the mounting screws on the opposite side and the top of the router should be level.

Reinstall Components into the Chassis

After you have installed the chassis into the rack, reinstall the router components into the chassis. The following procedures describe how to reinstall components into the chassis:

- Reinstall the SSB on page 109

- Reinstall the Craft Interface on page 110

- Reinstall the FPCs on page 112

- Connect the Router to External Devices on page 113

- Connect the PIC Cables on page 116

- Reinstall the Front Fan Trays on page 117

- Reinstall the Rear Fan Tray on page 118

- Reinstall the Routing Engine on page 119

- Reinstall and Wire the DC Power Supplies on page 121

- Reinstall the AC Power Supplies on page 124

> ⚠️ **Caution**
>
> The procedures in the following sections apply only to the initial installation of your router. If you are installing or replacing components when your router is operational, refer to the appropriate maintenance chapters. Failure to do so could result in damage to the router or network traffic being interrupted.

Reinstall the SSB

You reinstall the SSB into the front of the chassis above the craft interface. To reinstall the SSB, follow this procedure (see Figure 41):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Grasp the front of the SSB card carrier with both hands and align the rear of the card carrier with the slide guides on the chassis.

3. Slide the SSB card carrier all the way into the card cage until it contacts the midplane.

4. Flip the extractor clips, located on the left and right sides of the card carrier, towards each other to lodge the SSB in place.

5. Tighten the thumbscrews on the left and right sides of the card carrier to seat the SSB.

> **Note** To seat the SSB properly, be sure to tighten the screws adequately. If the SSB is not seated properly, it will not function.

Figure 41: Reinstall the SSB
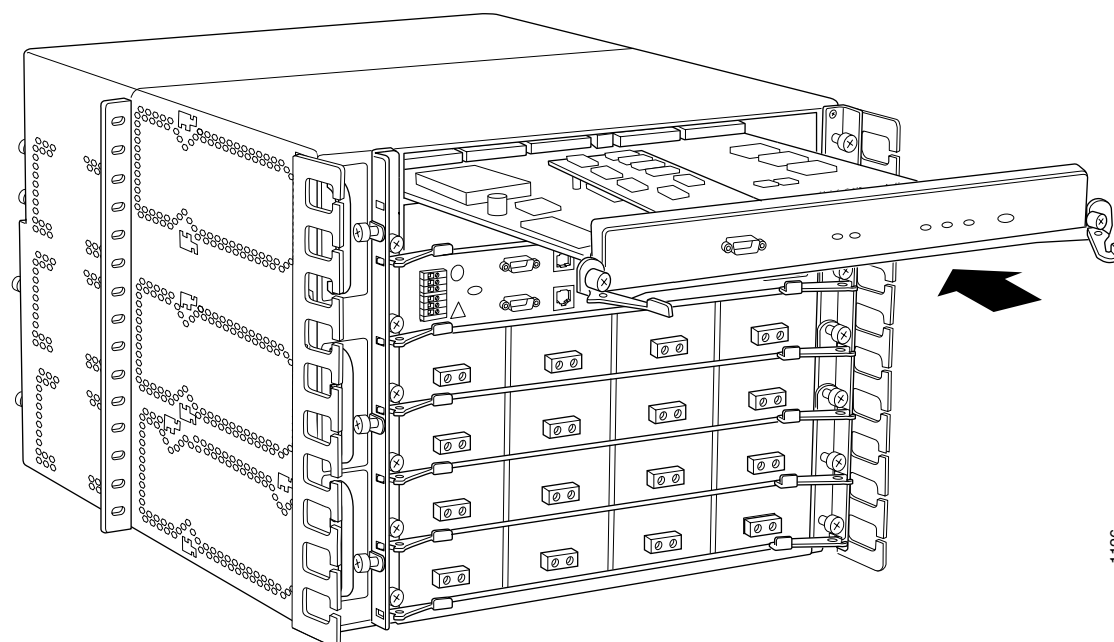
Reinstall the Craft Interface

You reinstall a craft interface into the front of the chassis above the FPCs. To reinstall the craft interface, follow this procedure (see Figure 42):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Grasp the front of the craft interface card carrier with both hands and align the rear of the card carrier with the slide guides on the chassis.

3. Slide the craft interface card carrier all the way into the card cage until it contacts the midplane.

4. Flip the extractor clips, located on the left and right sides of the card carrier, towards each other to secure the craft interface in place.

5. Tighten the thumbscrews on the left and right sides of the card carrier to seat the craft interface.

> **Note**
>
> To seat the craft interface properly, be sure to tighten the screws adequately. If the craft interface is not seated properly, it will not function.

Figure 42: Reinstall the Craft Interface
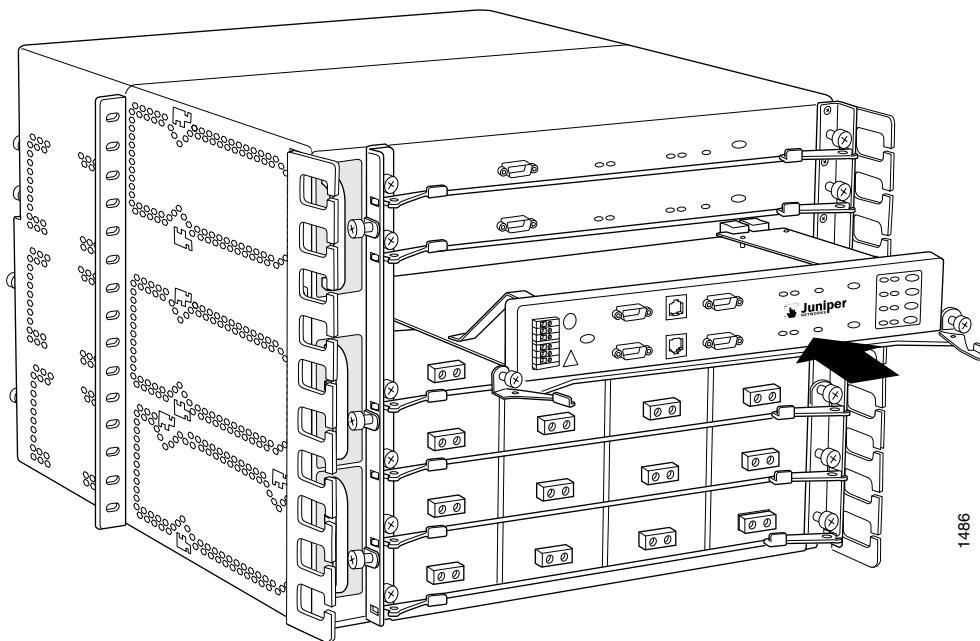
Reinstall the FPCs

To reinstall each FPC in the slot from which you removed it, follow this procedure (see Figure 43):

> **Note**
> You can reinstall the FPCs in any order. For purposes of organization, the following procedure arbitrarily directs you to install FPCs starting with the top FPC, FPC0.
>
> When installing multiple FPCs, allow 30 seconds between each FPC.

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. As you face the front of the chassis, locate the top FPC slot near the top of the chassis, which is just below the craft interface. This slot is labeled **FPC0**.

3. Locate the FPC that you labeled 0.

4. Grasp the front of the card carrier with both hands and align the rear of the FPC card carrier with the side guides of slot 0.

5. Slide the FPC all the way into the card cage until it contacts the midplane.

> **Caution**
> Sliding the FPC into the last inch of the card cage too quickly or too slowly could cause the system to reset. The last inch of travel should take between 1 and 15 seconds.

6. Flip the ends of the extractor clips, located on the left and right sides of the card carrier, toward each other to lodge the FPC into place.

7. Tighten the thumbcrews on the left and right sides of the card carrier to seat the FPC.

> **Note**
> To seat the FPCs properly, be sure to tighten the screws adequately.

8. Repeat Steps 4 through 7 to reinstall the remaining FPCs.

Figure 43: Reinstall the FPCs
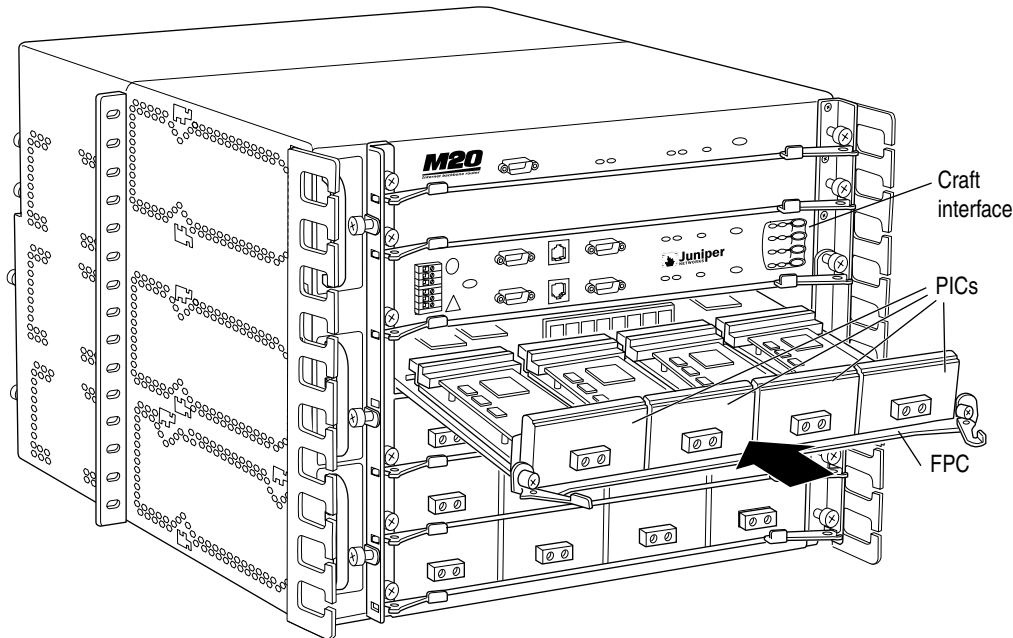
Connect the Router to External Devices

After you have reinstalled all components into the front of the router, you can connect external devices to the router. Figure 44 shows the location of the external device ports on the craft interface. Table 26 lists the cable specifications for each device.

Figure 44: Craft Interface Showing Ports to External Devices
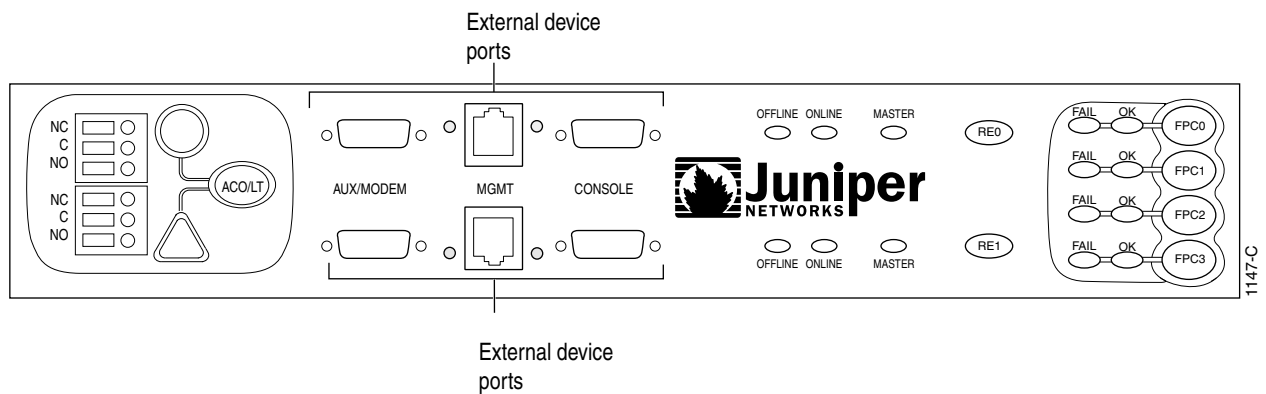
Table 26: Routing Engine External Device Cable Specifications

Cable Type	Cable Specification	Supplied	Maximum Length	Connector Specification
Routing Engine console interface	RS-232 serial	One 6-ft (1.83 m) length with DB-9/DB-9 connectors	6 ft (1.83 m)	DB-9 male
Routing Engine auxiliary interface	RS-232 serial	No	6 ft (1.83 m)	DB-9 male
Routing Engine Management Ethernet interface	Category 5 cable or equivalent suitable for 100BaseT operation	One 15-ft (4.58 m) length with RJ-45/RJ-45 connectors	328 ft (100 m)	RJ-45
Alarm card relay contacts	14–28 AWG wire	No	—	None

To connect external devices, follow these procedures:

- Connect a Management Console on page 114

- Connect an Auxiliary Device on page 115

- Connect to a Network for Out-of-Band Management on page 115

- Connect Alarm Relay Cables on page 115

Connect a Management Console

You can use a console to configure and manage the router. To connect a console to the router, follow this procedure:

1. Locate the appropriate cable and connector (see Table 26 and Figure 45).

2. Turn off the console power switch.

3. Plug the female end of the console cable connector into the upper CONSOLE serial port on the craft interface (see Figure 44).

4. Tighten the screws on the connector.

Figure 45: Console and Auxiliary Serial Port Connector
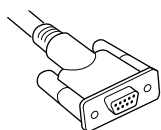
1027

Connect an Auxiliary Device

You can connect a modem, laptop, or other auxiliary device to the router. To connect an auxiliary device, follow this procedure:

1. Locate the appropriate cable and connector (see Table 26 and Figure 45).

2. Turn off the auxiliary device power switch.

3. Plug the female end of the auxiliary device cable connector into the upper AUXILIARY serial port on the craft interface (see Figure 44).

4. Tighten the screws on the connector.

Connect to a Network for Out-of-Band Management

You can connect the router to a network for out-of-band management. To connect the router to a network, follow this procedure:

1. Locate the appropriate cable and connector (see Table 26 and Figure 46).

2. Plug one of the Ethernet cable connectors into the upper MGMT port.

3. Plug the other connector into the network device.

Figure 46: Routing Engine Ethernet Cable Connector
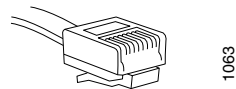
Connect Alarm Relay Cables

You can connect the router to an external alarm device so that conditions initiating a red or yellow alarm also trigger an external alarm device. Two sets of alarm relay contacts are located on the craft interface (see Figure 44). The upper alarm relay contact is triggered by a red alarm condition and the lower alarm relay contact is triggered by a yellow alarm condition.

To connect alarm relay contact cables, follow this procedure:

1. Locate two appropriate lengths of 14–28 AWG wire for use with the alarm relay terminal blocks.

2. For the upper alarm relay, unscrew the small screws on the terminal block of the alarm cable and attach the wire to the upper alarm relay contact.

3. Attach the other end of the wire to the external device to be activated by a higher-priority alarm.

4. For the lower alarm relay, unscrew the small screws on the terminal block of the alarm cable and attach a second wire to the lower alarm relay.

5. Attach the other end of the second wire to the external device to be activated by a lower-priority alarm.

Connect the PIC Cables

To connect the PIC cables into the PIC cable connectors at the front of the chassis, follow this procedure (see Figure 47):

1. Identify the appropriate cable to be connected to each PIC (see Table 27).

2. For fiber-optic PICs, remove the rubber safety plug from the PIC cable receptacle.

> **Warning** Do not look directly into optical PICs that are attached to an FPC. PICs that use SONET/SDH or ATM single-mode optical fiber contain laser light sources that can damage your eyes**.**

3. Insert the appropriate cable connector into the PIC receptacle.

4. Drape the cable over the covered metal hooks in the cable management device at the front left of the chassis (see Figure 2 on page 9) to prevent cables from dislodging or developing stress points. Secure the fiber so that it is not supporting its own weight as it dangles to the floor. Place excess fiber out of the way in a neatly coiled loop, either in the cable management system or in ladder racks above. Placing fasteners on the loop helps to maintain its shape.

> **Caution** Never let cable hang free from the PIC connector. Do not allow fastened loops of cable to dangle from the ladder rack because this stresses the cable at the fastening point**.**

Figure 47: Connect Cable to a PIC

PIC

Fiber-optic cable

1141
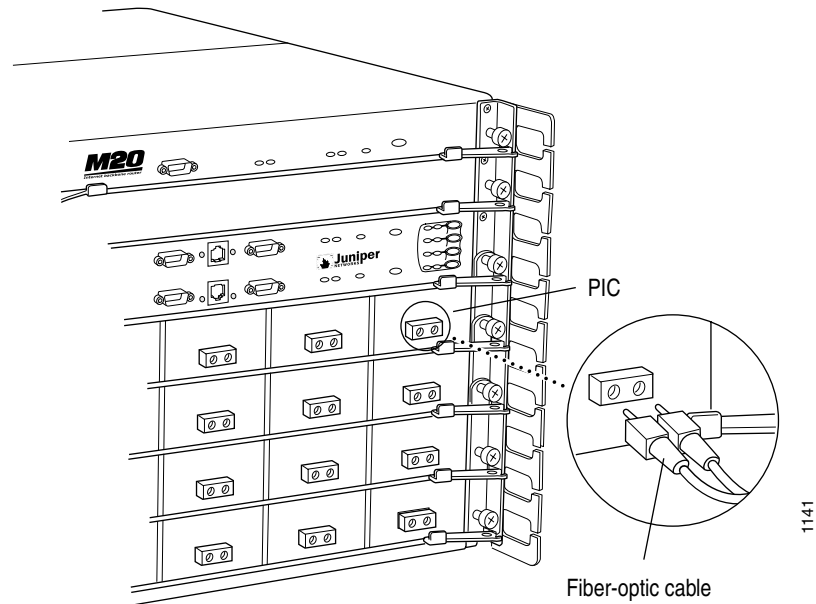
Table 27: PIC Cable Specifications

Cable Type	Cable Specification	Supplied	Maximum Length	Connector Specification
DS-3 interface	75-ohm coaxial	Yes	450 ft (137 m)	Mini-BNC
Single-mode interface (fiber)	SC-SC duplex	No	Short reach: 1.25 mi (2 km) Intermediate reach: 9.3 mi (15 km)	SC SC
Multimode interface (fiber)	SC-SC duplex	No	1.25 mi (2 km)	SC

Reinstall the Front Fan Trays

To reinstall the front fan trays into the left side of the chassis, follow this procedure (see Figure 48):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Slide the fan tray into the bay, aligning the screws at the corners of the fan tray with the mounting holes on the bay.

3. Using a screwdriver, tighten the thumbscrew.

> **Note**
>
> To seat the front fan tray properly, be sure to tighten the screw adequately.

4. Repeat Steps 2 and 3 for the other two fan trays.

Figure 48: Reinstall the Front Fan Tray
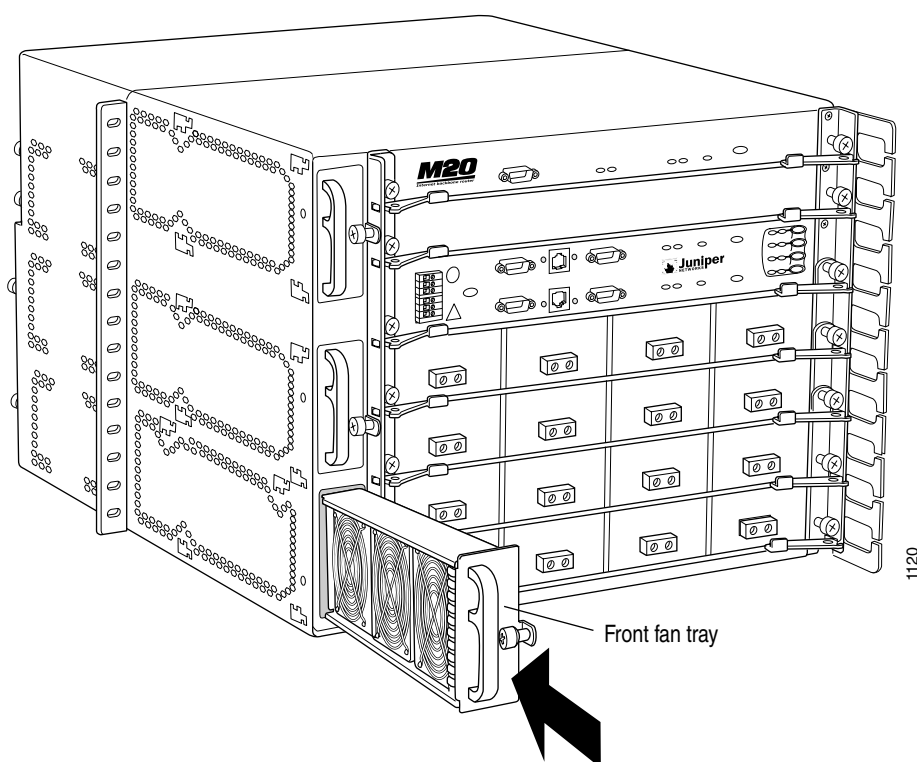
Front fan tray

1120

Reinstall the Rear Fan Tray

To reinstall the rear fan tray bay at the back of the chassis to the left of the Routing Engine, follow this procedure (see Figure 49):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Grasp the handle at the top of the fan tray and slide the tray all the way into the chassis.

3. Using a screwdriver, tighten the thumbscrew.

> **Note**
> To seat the rear fan tray properly, be sure to tighten the screw adequately.

Figure 49: Reinstall the Rear Fan Tray

Rear fan tray

Rear routing engine panel
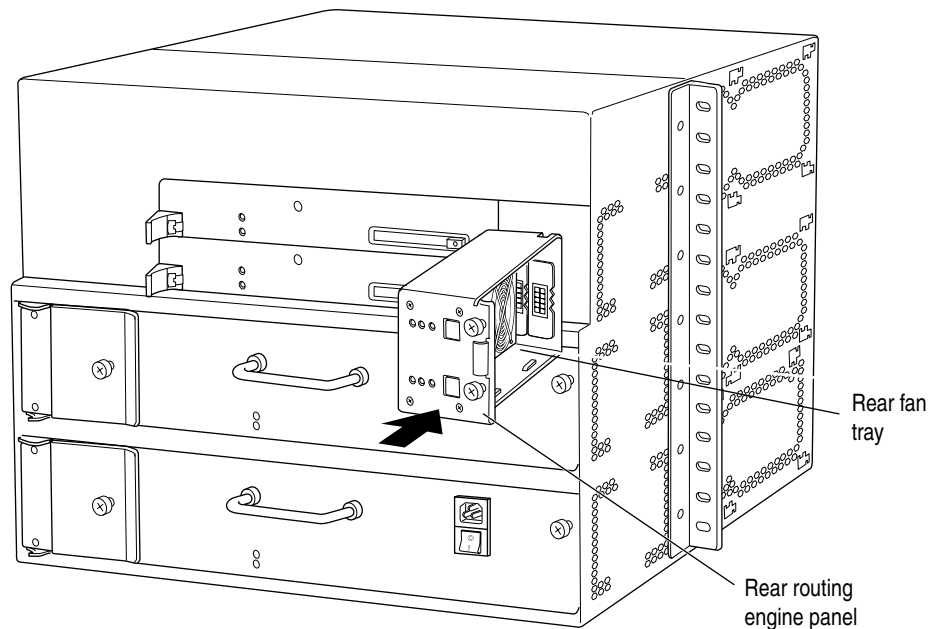
1144

Reinstall the Routing Engine

To reinstall the Routing Engine in the rear of the chassis above the power supplies, follow this procedure (see Figure 50):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Move one of your hands underneath the Routing Engine to support it and align the rear of the unit with the slide guides inside the chassis.

3. Slide the Routing Engine all the way into the card cage until it connects to the midplane.

> **Caution**
> When replacing the Routing Engine, slide the unit in evenly. If you push in one side faster than the other, the unit might get lodged in the rail and become damaged.

4. Flip the ends of the two extractor clips, which are adjacent to the thumbscrews, towards the inside of the router. This seats the Routing Engine into the midplane.

5. Using a screwdriver, screw in the thumbscrews on the left and right sides of the Routing Engine.

> To seat the Routing Engine properly, be sure to tighten the screws adequately.
>
> **Note**

Figure 50: Reinstall the Routing Engine

Rear Routing Engine panel

Routing Engine

Ejectors

1156

Reinstall and Wire the DC Power Supplies

You reinstall the DC power supplies into the bays at the lower rear of the chassis.

Before reinstalling the DC power supplies, note that the DC power supply cables attach to the power supply terminal studs with cable lugs. Each power supply has three cable interfaces: one input, one return, and one ground. The interfaces are 1/4–20 UNC terminal and grounding studs at 0.625-in. (15.86-mm) centers. Cable lugs have two holes that fit over the terminal and grounding studs. Table 7 on page 23 lists the DC power and grounding cable specifications.

⚠ Warning	The router has a connection between the grounded conductor of the DC supply circuit and the grounded conductor. You must directly connect the router to the DC supply system grounded electrode conductor, or to a bonding jumper from a grounded terminal bar or bus to which the DC supply system grounding electrode conductor is connected. If you do not, there can be a power hazard which could result in personal injury or damage to the router.

⚠ Warning	You must position the router in the same immediate area (such as adjacent cabinets) as any other equipment that is connected to the same the grounded conductor. The router also must be located in the same immediate area as the DC system's grounding point. The DC supply must not be grounded anywhere else. If the power supply is not grounded in this way, there can be a power hazard which could result in personal injury or damage to the router.

⚠ Warning	You must position the router within the same premises as the DC supply source. Failure to do so is an electrical hazard which could result in personal injury or damage to the router. Do not place switching or disconnecting devices in the grounded circuit conductor between the DC source and the point of the connection of the grounded electrode conductor.

For more information about DC power supplies, see the section "DC Power Supply Electrical Specifications" on page 49 and Table 14 on page 49.

To reinstall a DC power supply, follow this procedure (see Figure 52):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Verify that the power supply **ON/OFF** switch is in the **OFF** position and that the safety interlock lever below the power switch is disengaged (see Figure 51).

Figure 51: Flip the DC Power Switch Off
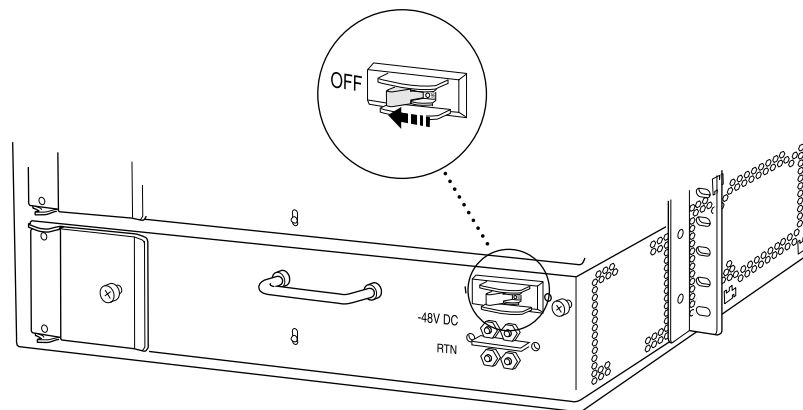
3. Grasp the power supply handle with one hand and move your other hand underneath the power supply to support it, and align the rear of the unit with the slide guides inside the chassis.

4. Slide the power supply into the chassis.

5. Flip the end of the ejector handle down. This seats the power supply into the midplane (see Figure 52).

Figure 52: Reinstall DC Power Supply

6. Using a screwdriver, screw in the thumbscrews on the left and right sides of the power supply. Be careful to not overtighten.

7. Remove the plastic protective shield covering the terminal studs.

8. Ensure that the voltage across the DC power source cable leads that you are connecting to the power supply is 0 V and that there is no chance that the cable leads might become active during the installation.

> ⚠ **Caution**
> There is no color code standard for the DC wiring. The color coding used by the site DC power source determines the color coding of the DC power cable leads to the DC power supply. You must ensure that the proper polarity is connected to the DC power supply. The power source DC cables might be marked with a (+) or a (–) label, indicating the cable polarity.

9. Secure the cable lug and ground wire to the grounding studs on the power supply faceplate.

10. Remove the nut and locking washer from each power supply terminal stud and attach the source DC power cable lugs to the power supply terminals (see Figure 53).

   ◼ Connect the positive (+) source DC power cable lug to the **RTN** (return) terminal on the power supply.

   ◼ Connect the negative (–) source DC power cable lug to the –48 V (input) terminal on the power supply.

Figure 53: DC Power Supply Terminal Studs
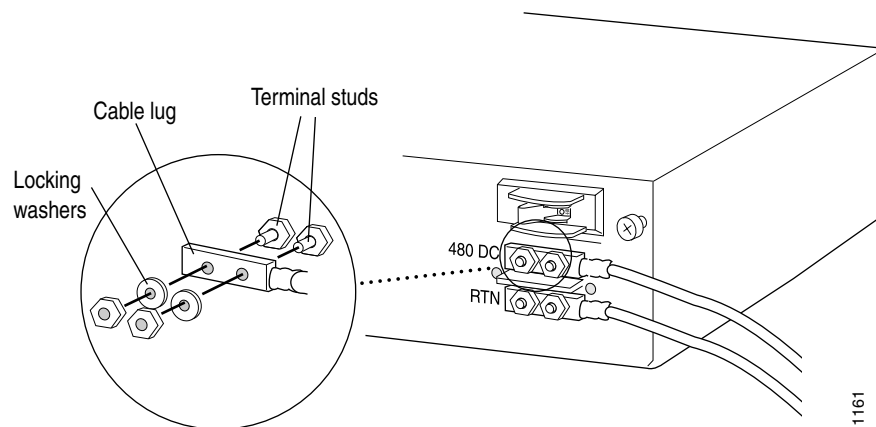
11. Secure the cable lug to the terminal stud.

12. Verify that the DC power source wiring from the source DC breaker to the power supply is correct.

13. Reinstall the plastic protective shield covering the terminal studs (see Figure 54).

14. Repeat Steps 2 through 13 for the second power supply.

Figure 54: Reinstall the DC Power Supply Protective Shield
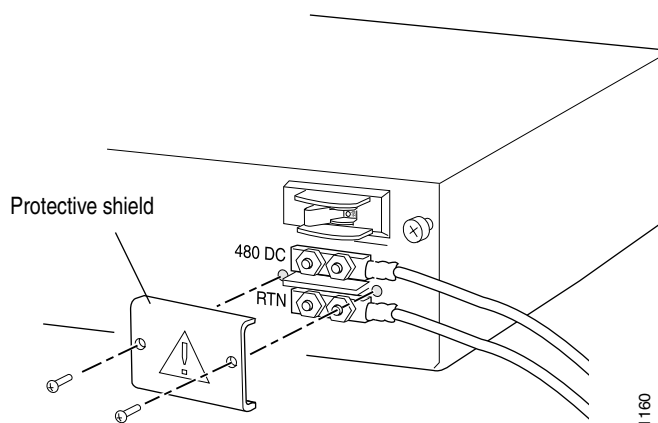
Reinstall the AC Power Supplies

You reinstall the AC power supplies in the power supply bays at the bottom rear of the chassis.

> **Note** The AC power supply contains an AC plug receptacle, which accepts one end of an external 2-1/2–m AC power cord. The other end of the AC power cord has a plug that fits into the power source receptacle that is standard for your geographic location. There are five types of plugs (see Figure 25 on page 47).

For more information about AC power supplies and cable specifications, see the section "AC Power Supply Electrical Specifications" on page 47.
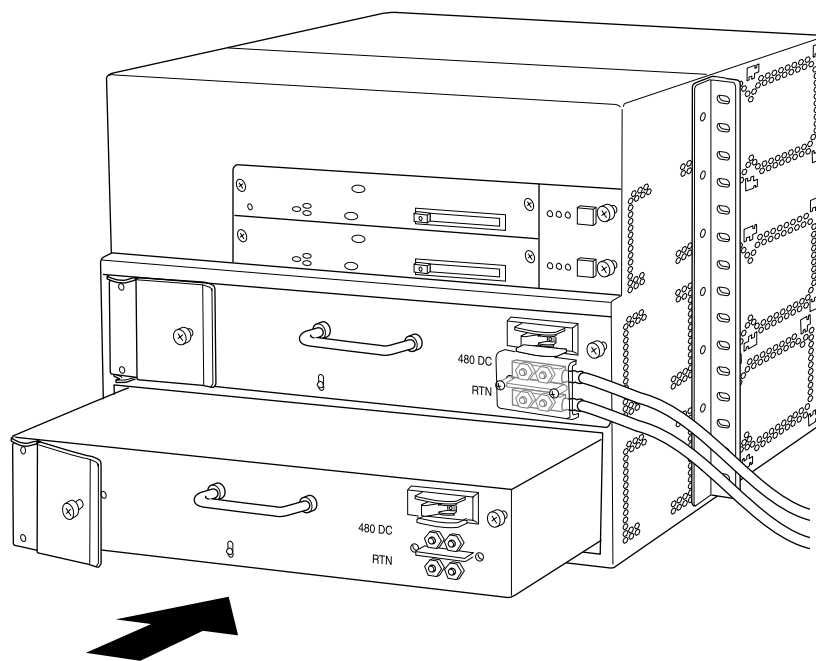
To reinstall the AC power supplies, follow this procedure (see Figure 55):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Verify that the power supply **ON/OFF** switch is in the **OFF** position.

3. Grasp the power supply handle with one hand and move your other hand underneath to support it, and align the rear of the unit with the slide guides inside the chassis.

4. Slide the power supply into the chassis.

5. Flip the end of the ejector handle down. This seats the power supply into the midplane.

6. Using a screwdriver, screw in the thumbscrews on the left and right sides of the power supply. Be careful to not overtighten.

7. Locate the AC power cord. Verify that the AC power cord shipped with the power supply is the correct type for your site (see Figure 25 on page 47).

> **Note** If you have received the wrong type of power cord, contact your service representative for a replacement.

8. Plug the AC power cord into the receptacle on the AC power supply.

9. Plug the other end of the power cord into the AC power source receptacle.

10. Repeat Steps 2 through 9 for the second power supply.

Figure 55: Reinstall the AC Power Supplies

Thumbscrew

Power supply ejector

1138
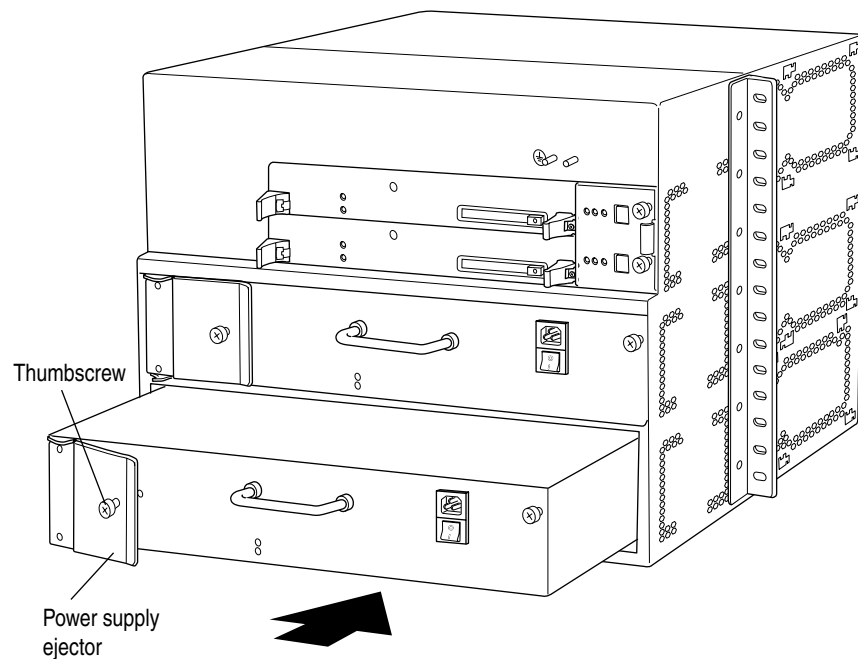
Power Up the Router

To power up the router, follow this procedure:

1. Make certain the ejector is clamped down and the thumbscrew is tightened

2. Turn on the power to the management device that is connected to the Routing Engine through the **CONSOLE**, **MGMT**, or **AUXILIARY** port.

3. Turn the power switch on each power supply to the ON position. The power supply LEDs should light up.

4. On the management device, monitor the startup process to verify that the system has booted properly.

Perform Initial Software Configuration

When you receive the router, the JUNOS Internet software is preinstalled and is ready to be configured when the router is powered on. The primary copy of the software is installed on a nonrotating flash disk, and two backup copies are included: one on the router's rotating hard disk and a second on a PC card that ships with the router. When the router boots, it first attempts to start the image from a PC card if one is installed in the Routing Engine. If this fails, the router next tries the flash disk, then finally the hard disk.

You can configure the router from a console attached to the **CONSOLE** port on the craft interface, or by using telnet over a network connected to the **MGMT** port. Before you configure the router, you need the following information:

- Name the router will use on the network

- Domain name the router will use

- IP address and prefix length information for the Ethernet interface

- IP address of a default router

- IP address of a DNS server

- Password for the root user

To configure the software, follow this procedure:

1. Power up the router as described in "Power Up the Router" on page 126.

2. Log in as the "root" user. There is no password.

3. Start the CLI.

        root# **cli**
        root@>

4. Enter configuration mode.

        cli> **configure**
        [edit]
        root@#

5. Configure the name of the router. If the name includes spaces, enclose the name in quotation marks (" ").

   > [edit]
   > root@# **set system host-name** *host-name*

6. Configure the router's domain name.

   > [edit]
   > root@# **set system domain-name** *domain-name*

7. Configure the IP address and prefix length for the router's Ethernet interface.

   > [edit]
   > root@# **set interfaces fxp0 unit 0 family inet address** *address/prefix-length*

8. Configure the IP address of a backup router, which is used only while the routing protocol is not running.

   > [edit]
   > root@# **set system backup-router** *address*

9. Configure the IP address of a DNS server.

   > [edit]
   > root@# **set system name-server** *address*

10. Set the root authentication password by entering either a clear-text password, an encrypted password, or an ssh public key string (DSA or RSA).

    > [edit]
    > root@# **set system root-authentication plain-text-password**
    > New password: *password*
    > Retype new password: *password*
    > or
    > [edit]
    > root@# **set system root-authentication encrypted-password** *encrypted-password*
    > or
    > [edit]
    > root@# **set system root-authentication ssh-dsa** *public-key*
    > or
    > [edit]
    > root@# **set system root-authentication ssh-rsa** *public-key*

11. Optionally, display the configuration to verify that it is correct.

```
[edit]
root@# show
system {
    host-name host-name;
    domain-name domain-name;
    backup-router address;
    root-authentication {
        authentication-method (password | public-key);
    }
    name-server {
        address;
    }
}
interfaces {
    fxp0 {
        unit 0 {
            family inet {
                address address/prefix-length;
            }
        }
    }
}
```

12. Commit the configuration. This activates the configuration on the router.

```
[edit]
root@# commit
```

13. Optionally, configure additional properties by adding the necessary configuration statements. Then, commit the changes to activate them on the router.

```
[edit]
root@host-name# commit
```

14. When you have finished configuring the router, exit configuration mode.

```
[edit]
root@host-name# exit
root@host-name>
```

The router is now connected to the network but is not fully configured. You must perform additional configuration before the router can pass traffic. For complete information about configuring the router, including examples, see the JUNOS Internet software configuration guides.

Part 3
Hardware Maintenance and Replacement Procedures

Chapter 9
Hardware Maintenance Overview

This chapter provides general guidelines and procedures for maintaining the router. The chapter discusses the following topics:

- Routine Maintenance Procedures on page 131

- Replace FRUs on page 131

- Return Parts for Repair or Replacement on page 131

The remaining chapters in this section describe how to maintain and replace the individual router components.

Routine Maintenance Procedures

Follow these guidelines for routine preventive maintenance of the router:

- Inspect installation site—Routinely inspect the installation site for potential problems caused by moisture, loose wires, and excessive dust. Make sure that the router has an unobstructed air flow.

- Check system status with the craft interface—Use the craft interface to routinely check the status of the router. The craft interface contains system alarms and system LEDs to inform you of potential problems. For a complete description of the craft interface, see the section "Craft Interface" on page 17.

Replace FRUs

To replace a FRU, you must first contact your sales representative to order the FRU.

The following chapters provide procedures for removing and replacing FRUs in the router. For a description of the FRUs for this router, see "Field-Replaceable Units (FRUs)" on page 4.

Return Parts for Repair or Replacement

For information about returning a part for repair or replacement, see the chapter "Return the Router or Its Components" on page 203.

Chapter 10
Maintain and Replace the Power Supplies

This chapter discusses the following topics related to maintaining and replacing the power supplies:

- Tools and Parts Required on page 133

- Maintain the Power Supplies on page 133

- Replace a DC Power Supply on page 134

- Replace an AC Power Supply on page 140

- Power Down the Router on page 144

Tools and Parts Required

To replace DC or AC power supplies, you need the following tools and parts:

- Phillips (+) screwdrivers, numbers 1 and 2

- Flat-blade (–) screwdrivers, 3/16-in. (5 mm) and 1/4-in. (6.5 mm)

- 1/4-inch socket wrench with torque setting

- Electrostatic discharge (ESD) grounding wrist strap

- Wire cutters

- Pliers

Maintain the Power Supplies

To maintain the power supplies, follow these guidelines:

- Make sure that the power and ground cables on each DC power supply are arranged so that they do not obstruct access to the other power supply or to the Routing Engine.

- Routinely check the LEDs on the power supply faceplate. The green **OK** LED indicates that the power supply is functioning normally; the yellow **FAIL** LED indicates a power supply fault. For more information about the power supply LEDs, see the section "Power Supply LEDs" on page 46.

■ Routinely check the red alarm LED on the front panel of the craft interface. A red alarm condition can be caused by a power supply fault.

■ The power supplies require an unobstructed air flow.

■ Periodically inspect the site to ensure that the cables connected to the power supply are securely in place and that they are properly insulated. For more information, see the sections "System Grounding Guidelines" on page 50 and "Site Wiring Guidelines" on page 52.

Replace a DC Power Supply

Both of the router's load-sharing, redundant DC power supplies install at the lower rear of the chassis. Each complete power supply, which includes an integrated fan, is field-replaceable. When one power supply is powered down, the other power supply automatically assumes the entire electrical load for the system.

To replace a DC power supply, use the following procedures:

■ Remove DC Power Supplies on page 135

■ Reinstall and Wire the DC Power Supplies on page 136

■ Verify That a DC Power Supply Is Installed Correctly on page 140

Warning	The router has a connection between the grounded conductor of the DC supply circuit and the grounded conductor. You must directly connect the router to the DC supply system grounded electrode conductor, or to a bonding jumper from a grounded terminal bar or bus to which the DC supply system grounding electrode conductor is connected. If you do not, there can be a power hazard which could result in personal injury or damage to the router.

Warning	You must position the router in the same immediate area (such as adjacent cabinets) as any other equipment that is connected to the same grounded conductor. The router also must be located in the same immediate area as the DC system's grounding point. The DC supply must not be grounded anywhere else. If the power supply is not grounded in this way, there can be a power hazard which could result in personal injury or damage to the router.

> ⚠
> **Warning**
>
> You must position the router within the same premises as the DC supply source. Failure to do so is an electrical hazard which could result in personal injury or damage to the router. Do not place switching or disconnecting devices in the grounded circuit conductor between the DC source and the point of the connection of the grounded electrode conductor.

Remove DC Power Supplies

The DC power supplies are located at the lower rear of the chassis. Each DC power supply weighs approximately 12 lb (5.5 kg).

To remove each of the DC power supplies, follow this procedure:

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Locate the power switch and flip it to the **OFF** position (see Figure 56).

Figure 56: Flip the DC Power Switch Off
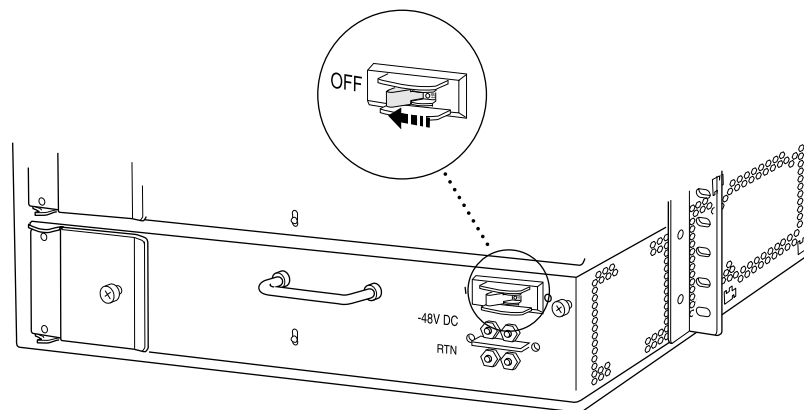
3. Undo the two thumbscrews attached to the power supply (one on the ejector handle and one on the opposite side) (see Figure 57) and pull back on the ejector handle. Turn the right screw a few rotations and then turn the left screw a few rotations to disengage the power supply from the midplane in a uniform manner.

> 👆
> **Note**
>
> You will probably need a screwdriver to loosen the thumbscrews.

Figure 57: Remove a DC Power Supply
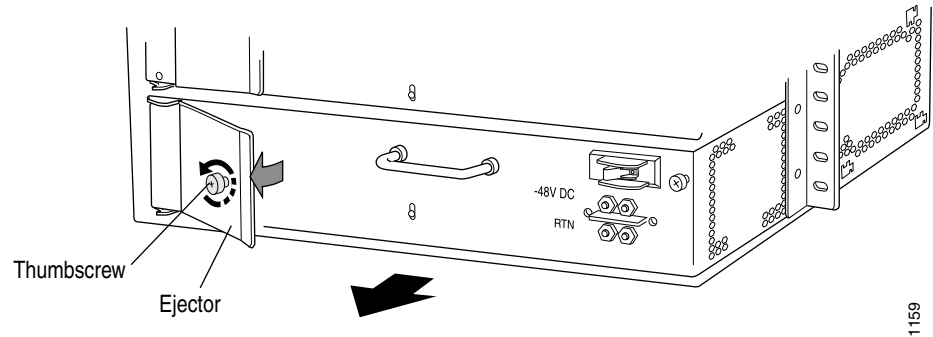
Thumbscrew

Ejector

4. Grasp the handle on the power supply faceplate with one hand. Slide the power supply about three quarters of the way out of the power supply bay.

5. Place your other hand underneath the power supply to support its weight and remove it from the chassis.

6. Repeat Steps 2 through 5 to remove the second power supply.

Reinstall and Wire the DC Power Supplies

You reinstall the DC power supplies into the bays at the lower rear of the chassis.

Before reinstalling the DC power supplies, note that the DC power supply cables attach to the power supply terminal studs with cable lugs. Each power supply has three cable interfaces: one input, one return, and one ground. The interfaces are 1/4–20 UNC terminal and grounding studs at 0.625-in. (15.86-mm) centers. Cable lugs have two holes that fit over the terminal and grounding studs. Table 7 on page 23 lists the DC power and grounding cable specifications.

> **Warning**
>
> The router has a connection between the grounded conductor of the DC supply circuit and the grounded conductor. You must directly connect the router to the DC supply system grounded electrode conductor, or to a bonding jumper from a grounded terminal bar or bus to which the DC supply system grounding electrode conductor is connected. If you do not, there can be a power hazard which could result in personal injury or damage to the router.

> ⚠️ **Warning**
>
> You must position the router in the same immediate area (such as adjacent cabinets) as any other equipment that is connected to the same the grounded conductor. The router also must be located in the same immediate area as the DC system's grounding point. The DC supply must not be grounded anywhere else. If the power supply is not grounded in this way, there can be a power hazard which could result in personal injury or damage to the router.

> ⚠️ **Warning**
>
> You must position the router within the same premises as the DC supply source. Failure to do so is an electrical hazard which could result in personal injury or damage to the router. Do not place switching or disconnecting devices in the grounded circuit conductor between the DC source and the point of the connection of the grounded electrode conductor.

For more information about DC power supplies, see the section "DC Power Supply Electrical Specifications" on page 49 and Table 14 on page 49.

To reinstall a DC power supply, follow this procedure (see Figure 59):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Verify that the power supply **ON/OFF** switch is in the **OFF** position and that the safety interlock lever below the power switch is disengaged (see Figure 58).

Figure 58: Flip the DC Power Switch Off
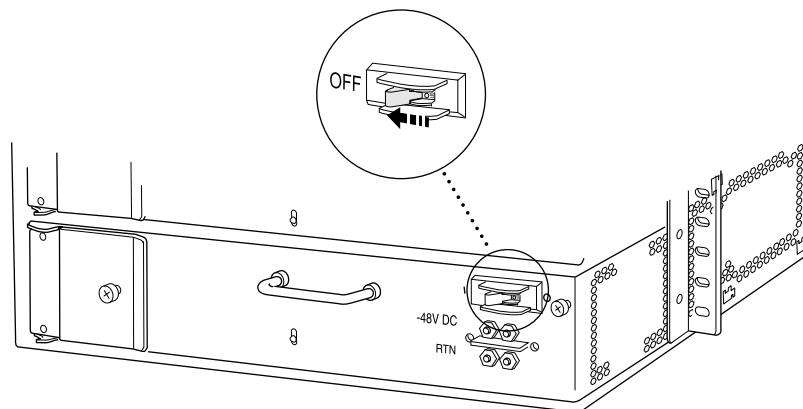
3. Grasp the power supply handle with one hand and move your other hand underneath the power supply to support it, and align the rear of the unit with the slide guides inside the chassis.

4. Slide the power supply into the chassis.

5. Flip the end of the ejector handle down. This seats the power supply into the midplane (see Figure 59).

Figure 59: Reinstall DC Power Supply

6. Using a screwdriver, screw in the thumbscrews on the left and right sides of the power supply. Be careful to not overtighten.

7. Remove the plastic protective shield covering the terminal studs.

8. Ensure that the voltage across the DC power source cable leads that you are connecting to the power supply is 0 V and that there is no chance that the cable leads might become active during the installation.

> ⚠ **Caution**
> There is no color code standard for the DC wiring. The color coding used by the site DC power source determines the color coding of the DC power cable leads to the DC power supply. You must ensure that the proper polarity is connected to the DC power supply. The power source DC cables might be marked with a (+) or a (–) label, indicating the cable polarity.

9. Secure the cable lug and ground wire to the grounding studs on the power supply faceplate.

10. Remove the nut and locking washer from each power supply terminal stud and attach the source DC power cable lugs to the power supply terminals (See Figure 60).

    ■ Connect the positive (+) source DC power cable lug to the **RTN** (return) terminal on the power supply.

    ■ Connect the negative (–) source DC power cable lug to the –48 V (input) terminal on the power supply.

Figure 60: DC Power Supply Terminal Studs
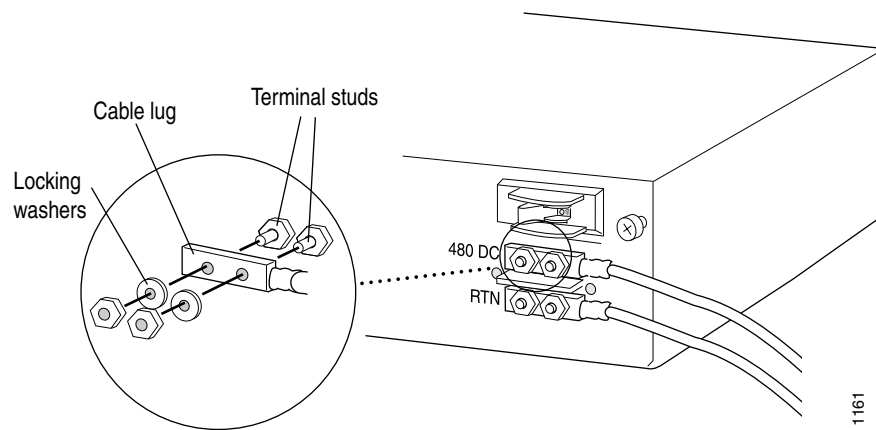
11. Secure the cable lug to the terminal stud.

12. Verify that the DC power source wiring from the source DC breaker to the power supply is correct.

13. Reinstall the plastic protective shield covering the terminal studs (see Figure 61).

14. Repeat Steps 2 through 13 for the second power supply.

Figure 61: Reinstall the DC Power Supply Protective Shield
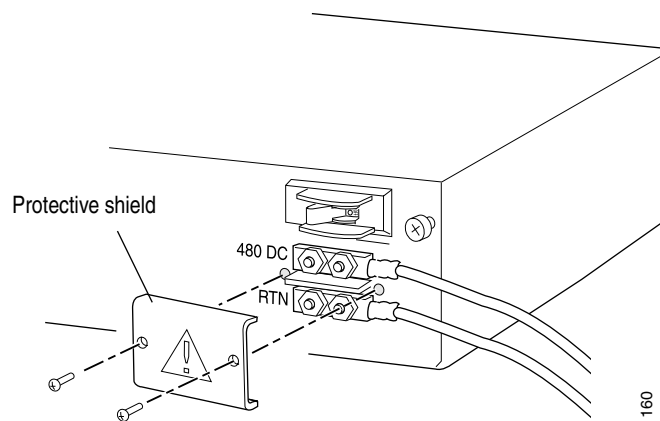
Verify That a DC Power Supply Is Installed Correctly

Verify that a DC power supply is installed correctly:

1. Make certain the ejector is clamped down and the thumbscrew is tightened.

2. Turn the power switch on the power supply to the **ON** position.

If the power supply is functioning normally, the green **OK** power supply LED directly below the handle lights.

> Turning on the power supply causes the router to boot.
>
> **Note**

Replace an AC Power Supply

Both of the router's load-sharing, redundant AC power supplies install at the lower rear of the chassis, in the power supply bays. Each complete power supply module, which includes an integrated fan, is field-replaceable. When one power supply is powered down, the other power supply automatically assumes the entire electrical load for the system.

To replace an AC power supply, use the following procedures:

■ Remove the AC Power Supplies on page 141

■ Reinstall the AC Power Supplies on page 142

■ Verify That an AC Power Supply Is Installed Correctly on page 143

Remove the AC Power Supplies

The AC power supplies are located at the bottom rear of the chassis. Each AC power supply weighs approximately 12 lb (5.5 kg).

To remove each of the AC supplies, follow this procedure (see Figure 62):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Locate the power switch and flip it to the **OFF** position.

3. Undo the two thumbscrews attached to the power supply (one on the ejector handle and one on the opposite side), and pull back on the ejector handle. Turn the right screw a few rotations and then turn the left side screw a few rotations to disengage the power supply from the midplane in a uniform manner.

> You will probably need a screwdriver to loosen the thumbscrews.
>
> **Note**

4. Grasp the handle on the power supply faceplate with one hand. Slide the power supply about three quarters of the way out of the power supply bay.

5. Place your other hand underneath the power supply to support its weight and remove it from the chassis.

6. Repeat Steps 2 through 5 to remove the second power supply.

Figure 62: Remove an AC Power Supply
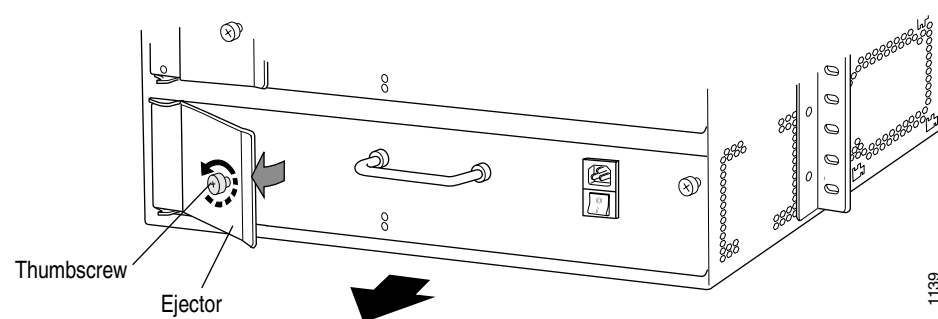
Thumbscrew

Ejector

1139

Reinstall the AC Power Supplies

You reinstall the AC power supplies in the power supply bays at the bottom rear of the chassis.

> **Note** The AC power supply contains an AC plug receptacle, which accepts one end of an external 2-1/2–m AC power cord. The other end of the AC power cord has a plug that fits into the power source receptacle that is standard for your geographic location. There are five types of plugs (see Figure 25 on page 47).

For more information about AC power supplies and cable specifications, see the section "AC Power Supply External Interfaces and Power Cords" on page 47.

To reinstall the AC power supplies, follow this procedure (see Figure 63):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Verify that the power supply **ON/OFF** switch is in the **OFF** position.

3. Grasp the power supply handle with one hand and move your other hand underneath to support it, and align the rear of the unit with the slide guides inside the chassis.

4. Slide the power supply into the chassis.

5. Flip the end of the ejector handle down. This seats the power supply into the midplane.

6. Using a screwdriver, screw in the thumbscrews on the left and right sides of the power supply. Be careful to not overtighten.

7. Locate the AC power cord. Verify that the AC power cord shipped with the power supply is the correct type for your site (see Figure 25 on page 47).

> **Note** If you have received the wrong type of power cord, contact your service representative for a replacement.

8. Plug the AC power cord into the receptacle on the AC power supply.

9. Plug the other end of the power cord into the AC power source receptacle.

10. Repeat Steps 2 through 9 for the second power supply.

Figure 63: Reinstall the AC Power Supplies

Thumbscrew

Power supply
ejector

1138
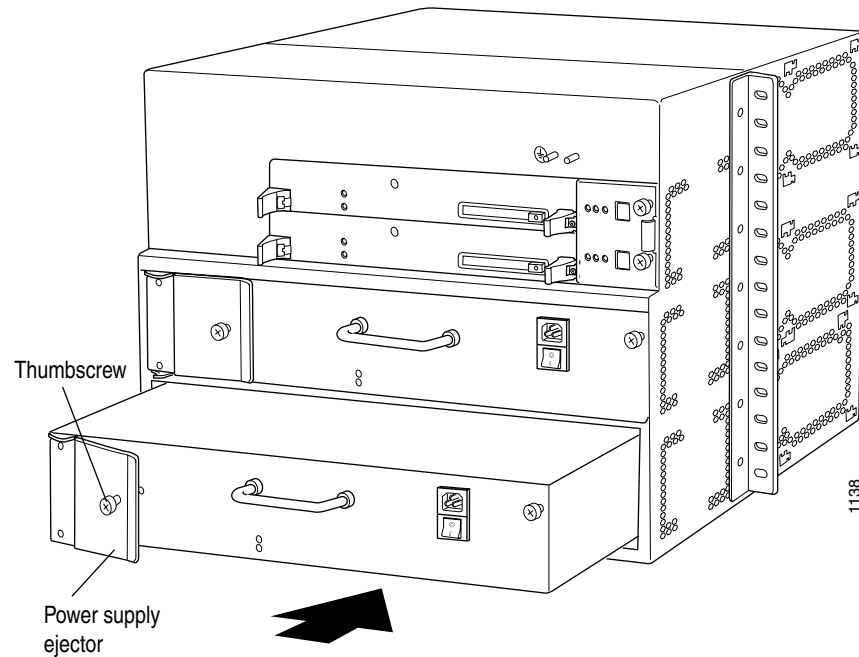
Verify That an AC Power Supply Is Installed Correctly

To verify that an AC power supply is installed correctly, follow this procedure:

1. Make certain the ejector is clamped down and the thumbscrew is tightened.

2. Turn the power switch on the power supply to the **ON** position.

If the power supply is functioning normally, the green **OK** power supply LED directly below the handle lights.

> Turning on the power supply causes the router to boot.
>
> **Note**

Power Down the Router

To power down the router, follow this procedure:

1. From the CLI, enter the **request system halt** command. This stops packet forwarding.

2. Wait for the "System halted" message on the console.

3. Turn off power to the router. For DC or AC power supplies, attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis. Locate the power switch and flip it to the **OFF** position.

4. Repeat Step 3 to turn off the second power supply.

> ⚠
> **Caution**
>
> If you do not take the Routing Engine offline or use the CLI to halt the system before powering down the router, you might lose traffic.

Chapter 11
Maintain and Replace Cooling System Components

This chapter discusses the following topics related to maintaining and replacing the router cooling system components:

- Tools and Parts Required on page 145

- Fan Assembly Maintenance on page 145

    - Remove the Front Fan Trays on page 146

    - Reinstall the Front Fan Trays on page 147

    - Remove the Rear Fan Tray on page 148

    - Reinstall the Rear Fan Tray on page 149

Tools and Parts Required

You need the following tools and parts to replace cooling system components:

- Phillips (+) screwdrivers, numbers 1 and 2

- Flat-blade (–) screwdrivers, 3/16-in. and 1/4-in.

- Electrostatic discharge (ESD) grounding wrist strap

Fan Assembly Maintenance

The router cooling system consists of the following components:

- Three front fan trays—Cool the FPCs and the SSB. These fan trays are located on the left front side of the chassis.

- One rear fan tray—Cools the Routing Engine. This fan tray is located immediately to the right of the Routing Engine.

- Power supply integrated fan—A built-in fan cools each power supply.

The fan trays work together to provide side-to-side cooling (see Figure 15 on page 25).

The fan trays plug directly into the router midplane.

Each front fan tray is a single field-replaceable unit that contains three fans. The rear fan tray is a field-replaceable unit that contains one fan. Both front and rear fan trays are hot-swappable.

> **Note**
> The router should not be operated for more than 1 minute without a fan tray.

This section discusses how to remove and replace the router's front and rear fans:

- Remove the Front Fan Trays on page 146

- Reinstall the Front Fan Trays on page 147

- Remove the Rear Fan Tray on page 148

- Reinstall the Rear Fan Tray on page 149

Remove the Front Fan Trays

The three front fan trays are located at the front left of the chassis. Each fan tray, which houses three separate fan assemblies, weighs approximately 5 lb (2 kg).

To remove the fan tray, follow this procedure (see Figure 64):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Unscrew the thumbscrew near the middle of the fan tray.

3. Grasp the fan tray handle and slide the tray three quarters of the way out of the chassis.

4. Move one of your hands underneath the fan tray to support it and slide the fan tray completely out of the chassis.

5. Repeat Steps 2 through 4 to remove the remaining two front fan trays.

Figure 64: Remove a Front Fan Tray
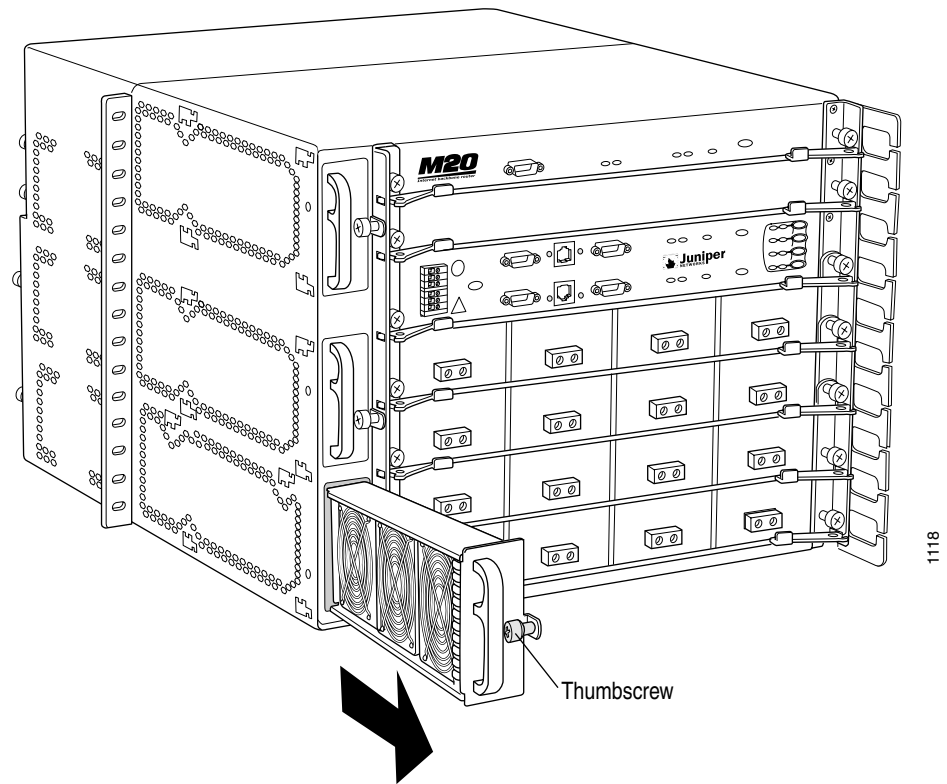
Thumbscrew

Reinstall the Front Fan Trays

To reinstall the front fan trays into the left side of the chassis, follow this procedure (see Figure 65):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Slide the fan tray into the bay, aligning the screws at the corners of the fan tray with the mounting holes on the bay.

3. Using a screwdriver, tighten the thumbscrew.

> To seat the front fan tray properly, be sure to tighten the screw adequately.
>
> **Note**

4. Repeat Steps 2 and 3 for the other two fan trays.

Figure 65: Reinstall the Front Fan Tray

Front fan tray

Remove the Rear Fan Tray

The rear fan tray is located at the top right side of the rear of the chassis above the power supplies. The rear fan tray weighs approximately 2 lb (1 kg).

To remove the rear fan tray, follow this procedure (see Figure 66):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Loosen the two thumbscrews at the right side of the tray.

> You will probably need a screwdriver to loosen the thumbscrews.
>
> **Note**

3. Pulling on the small handle, slide the rear fan tray out of the chassis.

Figure 66: Remove the Rear Fan Tray

Reinstall the Rear Fan Tray

To reinstall the rear fan tray bay at the back of the chassis to the left of the Routing Engine, follow this procedure (see Figure 67):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Grasp the handle at the top of the fan tray and slide the tray all the way into the chassis.

3. Using a screwdriver, tighten the thumbscrew.

> **Note** To seat the rear fan tray properly, be sure to tighten the screw adequately.

Figure 67: Reinstall the Rear Fan Tray

Rear fan
tray

Rear Routing
Engine panel
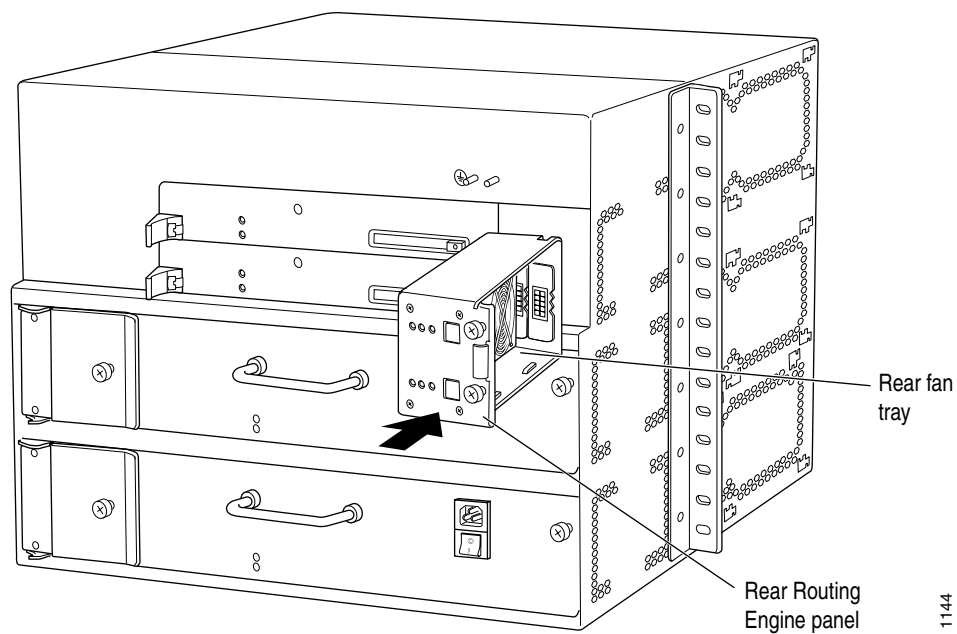
1144

Chapter 12
Maintain and Replace Packet Forwarding Engine Components

This chapter discusses the following topics about maintaining and replacing Packet Forwarding Engine components:

Tools and Parts Required

You need the following tools and parts to replace Packet Forwarding Engine components:

- Philips (+) screwdrivers, numbers 1 and 2

- Flat-blade (–) screwdrivers, 3/16-in. and 1/4-in.

- Electrostatic bags, one for each Flexible PIC Concentrator (FPC) and Physical Interface Card (PIC) removed

- Antistatic mat, placed on a flat, stable surface

- Electrostatic discharge (ESD) grounding wrist strap

■ Replacement FPC or blank card carriers, one for each FPC that you are removing

■ Replacement PIC or PIC blank, one for each PIC that you are removing

■ Rubber safety caps that fit over PIC cable connectors, one for each SONET/SDH or ATM PIC that you are removing

FPC and PIC Maintenance

To maintain the FPCs and PICs, follow these guidelines:

■ To display status information about installed FPCs and PICs, use the command-line interface (CLI) to display information about the FPCs. Enter the following command:

> user@host> **show chassis fpc**

You can get more detailed information by entering the following option:

> user@host> **Show chassis fpc detail**

For complete information about configuring and using the software, including examples, see the JUNOS Internet software manuals.

■ Check system LEDs.

Replace an FPC

This section discusses the following topics related to replacing FPCs :

■ Remove the FPCs on page 152

■ Reinstall the FPCs on page 154

■ Verify That an FPC is Installed Correctly on page 156

Remove the FPCs

The FPCs are located on the front of the chassis below the craft interface. Each FPC, fully configured with four PICs, weighs about 3 lb (1.5 kg).

> **Note**
> You can remove FPCs in any order. For purposes of organization, the following procedure arbitrarily directs you to remove FPCs starting at the top of the chassis and moves down. Whatever order you use, you should label each FPC with its slot number as you remove it (see Table 28) so you know where to replace it.

Table 28: FPC Removal Checklist

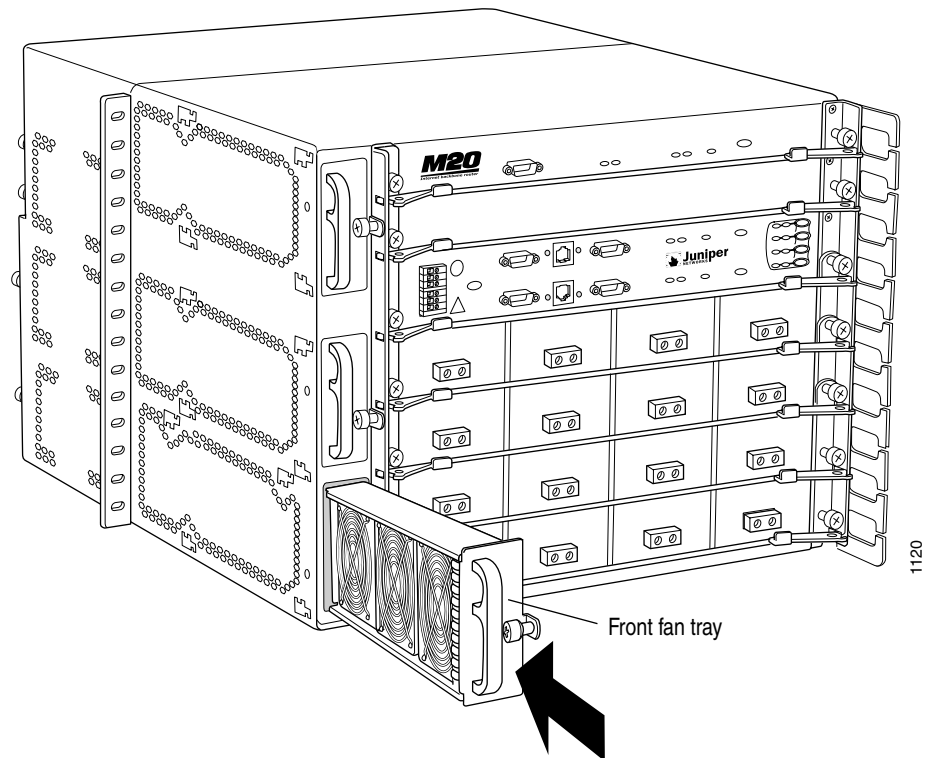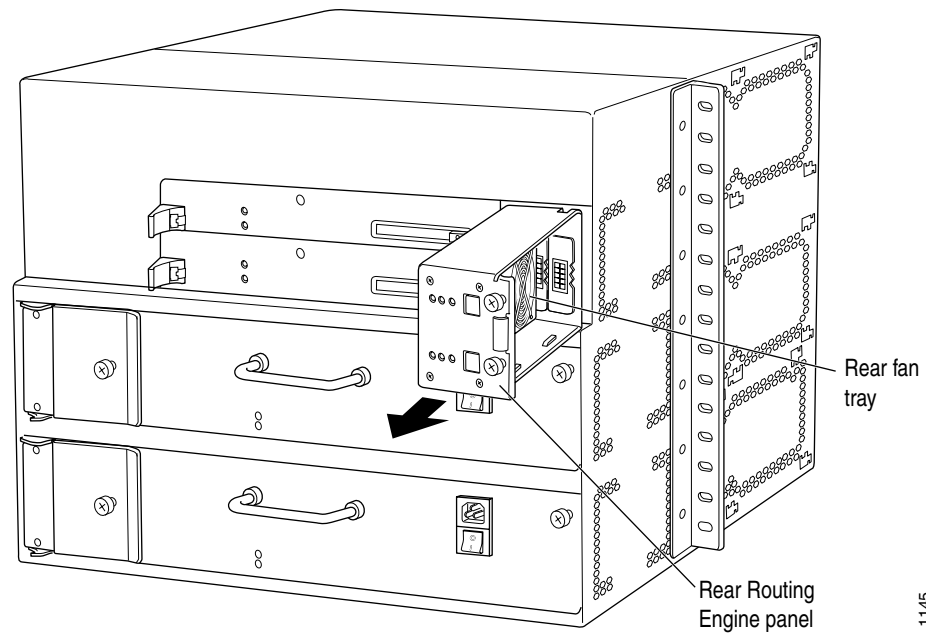| Slot	Media Type	Removed	Reinstalled
0			
1			
2			
3			

To remove the FPCs, follow this procedure (see Figure 68):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Locate the FPC immediately below the craft interface. This FPC is labeled FPC0. The label is stamped on the chassis to the right of the FPC.

3. Unscrew the thumbscrews on the left and right sides of the card carrier to unseat the FPC from the midplane.

4. Flip the ends of the two extractor clips, which are adjacent to the thumbscrews, towards the outside edges of the router.

5. Grasp both sides of the card carrier and slide the FPC about three quarters of the way out of the router.

6. Move one of your hands underneath the FPC to support it, and slide it completely out of the chassis.

7. Moving from top to bottom, repeat Steps 3 through 6 to remove the remaining three FPCs from the chassis.

Figure 68: Remove an FPC
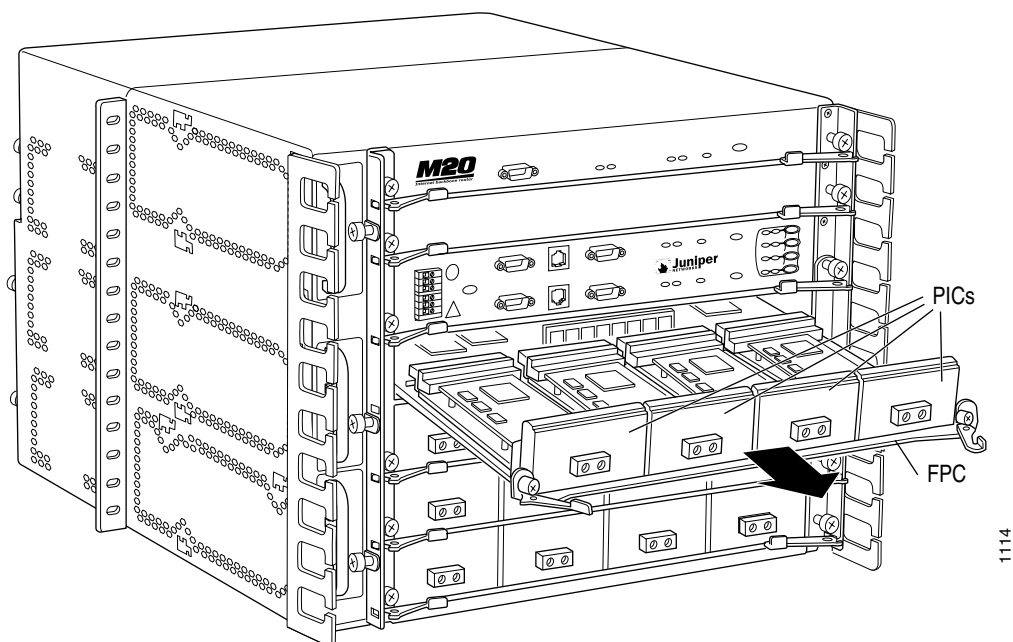
Reinstall the FPCs

To reinstall each FPC in the slot from which you removed it, follow this procedure (see Figure 69):

> **Note**
>
> You can reinstall the FPCs in any order. For purposes of organization, the following procedure arbitrarily directs you to install FPCs starting with the top FPC, FPC0.
>
> When installing multiple FPCs, allow 30 seconds between each FPC.

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. As you face the front of the chassis, locate the top FPC slot near the top of the chassis, which is just below the craft interface. This slot is labeled **FPC0**.

3. Locate the FPC that you labeled 0.

4. Grasp the front of the card carrier with both hands and align the rear of the FPC card carrier with the side guides of slot 0.

5. Slide the FPC all the way into the card cage until it contacts the midplane.

> ⚠️ **Caution**
>
> Sliding the FPC into the last inch of the card cage too quickly or too slowly could cause the system to reset. The last inch of travel should take between 1 and 15 seconds.

6. Flip the ends of the extractor clips, located on the left and right sides of the card carrier, toward each other to secure the FPC into place.

7. Tighten the thumbcrews on the left and right sides of the card carrier to seat the FPC.

> **Note**
>
> To seat the FPCs properly, be sure to tighten the screws adequately.

8. Repeat Steps 4 through 7 to reinstall the remaining FPCs.

Figure 69: Reinstall the FPCs
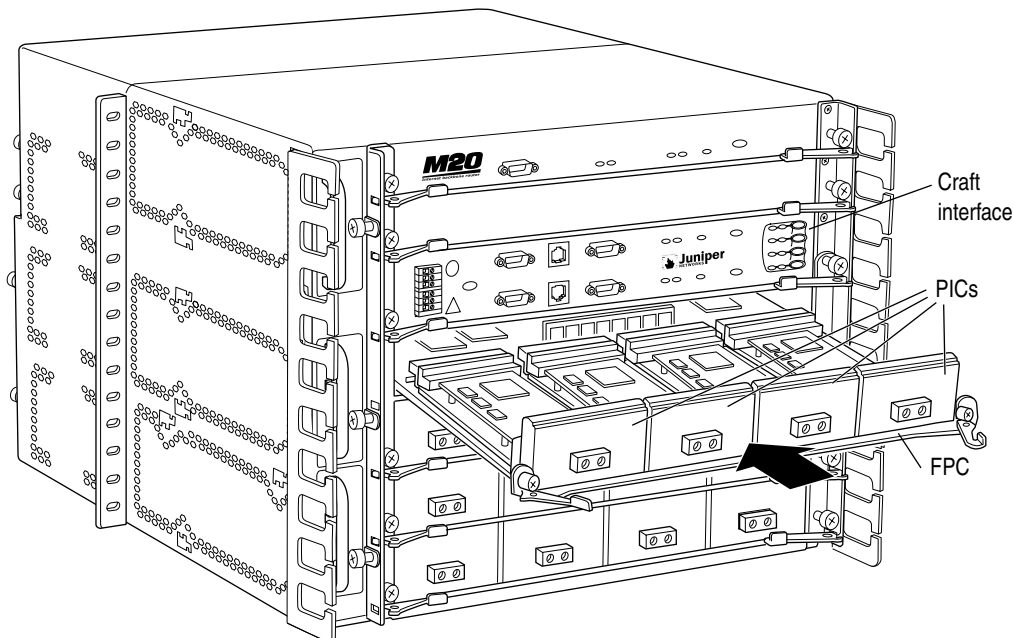
Verify That an FPC is Installed Correctly

As soon as the FPC is seated (providing the router is turned on), the Routing Engine downloads the FPC software, the FPC runs its diagnostics, and the PICs on the FPC card are enabled. You can verify that this process is occurring by checking that the green OK LED beneath the FPC is blinking as the FPC starts up. The backplane flushes the entire system memory pool before the new card is brought online, a process that takes about 200 ms. When the FPC is online, the green OK LED beneath the FPC is on steadily.

To check the status of the FPCs and PICs, enter the following CLI command:

user@host> **show chassis fpc pic** *fpc-slot*

For more information about using the CLI to get information about the FPCs and PICs, see the JUNOS Internet software documentation.

Each port on each PIC has one LED, located on the PIC faceplate above the optical transceiver. Each LED has four different states, which are described in Table 29. If the FPC that houses the PIC detects a PIC failure, the FPC informs the SCB, which in turn sends an alarm to the Routing Engine.

Replace a PIC

This section discusses the following topics related to replacing PICs:

- Remove a PIC on page 156

- Install a Replacement PIC on page 157

- Remove a Quad-Wide PIC on page 158

- Install a Replacement Quad-Wide PIC on page 159

- Verify That a PIC is Installed Correctly on page 159

- OC-48 PIC Interoperability on page 160

Remove a PIC

To remove a PIC from an FPC, follow this procedure:

1. Attach an ESD wrist strap to your bare wrist, and connect the wrist strap to one of the two ESD points on the chassis.

> Before you remove a PIC from an FPC, you must first remove the FPC from the router.
>
> **Note**

2. Using a screwdriver, loosen the two screws on the noncomponent side that fasten each PIC to the FPC.

3. Unplug the PIC from its appropriate slot on the host FPC, by pulling the PIC straight out from the FPC.

4. Pull the PIC out evenly to prevent damage to the PIC.

5. Place the PIC in an electrostatic bag.

Install a Replacement PIC

To install a replacement PIC, follow this procedure (see Figure 70):

1. Attach an ESD wrist strap to your bare wrist, and connect the wrist strap to one of the two ESD points on the chassis.

2. Take the replacement PIC out of its electrostatic bag, and identify the slot on the FPC where it is to be connected.

3. Plug the PIC into its appropriate slot on the FPC (see Figure 70). Do this by aligning the notches at the rear connector on the PIC with the notches on the FPC and then firmly pushing the PIC into place.

> **⚠ Caution**
>
> Ensure that the notches are aligned before pushing the PIC into the FPC. If they are not aligned, the pins of the PIC might bend when you insert the PIC, which might result in damage to the equipment.

Figure 70: Install a PIC

1007
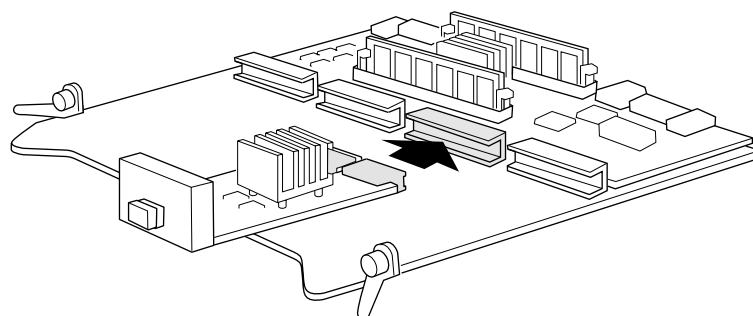
4. Using a screwdriver, tighten the two screws on the noncomponent side that fasten each PIC to the FPC.

Replace a Quad-Wide PIC

The OC-48 PIC is a quad-wide PICs that combines the functions of a PIC and an FPC. This PIC occupies an entire FPC slot, and is removed and replaced in the same manner as an FPC.

This section discusses the following topics related to replacing quad-wide PICs:

- Remove a Quad-Wide PIC on page 158

- Install a Replacement Quad-Wide PIC on page 159

- Verify That a PIC is Installed Correctly on page 159

Remove a Quad-Wide PIC

To remove a quad-wide PIC, follow this procedure:

1. Have ready an antistatic mat for the PIC that you are removing.

2. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

3. Locate the PIC you plan to replace.

4. Locate the FPC offline switch on the craft interface corresponding to the PIC you want to remove. Press and hold down the offline switch for five seconds to take the PIC offline.

5. Label the cables connected to the PIC so that you can reconnect each cable to the right PIC.

> **Warning**
> Do not look directly into the PIC ports. PICs that use SONET or ATM single-mode optical fiber contain laser light sources that can damage your eyes.

6. Remove the cables plugged into the PIC and immediately place a safety cap over each port.

7. Carefully drape each disconnected cable over the covered metal hooks in the cable management system on the sides of the chassis to prevent the cables from developing stress points.

> **Caution**
> Avoid bending fiber-optic cable beyond its bend radius. An arc smaller than a few inches can damage the cable and cause problems that are difficult to diagnose.

8. Unscrew the thumbscrews on the ends of the PIC to unseat it from the midplane.

9. Flip the ends of the two ejector levels on the ends of the PIC away from each other.

10. Grasp the PIC by the ejector levers and slide it about three-quarters of the way out of the router.

11. Place one of your hands underneath the PIC to support it, and slide it completely out of the router.

Install a Replacement Quad-Wide PIC

To install a replacement quad-wide PIC, follow this procedure:

1. Attach an ESD wrist strap to your bare wrist, and connect the wrist strap to one of the two ESD points on the chassis.

2. Locate the slot in the card cage where you plan to install the PIC.

3. Extend the ejector levers on the PIC so they are protruding.

4. Lift the PIC and carefully align the rear of the PIC with the guides at the top and bottom of the FPC slot.

5. Slide the PIC all the way into the card cage until it contacts the midplane.

6. Flip the ends of the ejector levers toward each other to lodge the PIC into place.

7. Tighten the thumbscrews on the ends of the PIC to secure it.

> ⚠️ **Caution**
>
> To seat the quad-wide PIC properly, be sure to tighten the screws adequately.

8. Remove the safety cap from the cables you plan to connect to the PIC.

9. Reconnect the fiber-optic cables to the PIC.

Verify That a PIC is Installed Correctly

Each port on each PIC has a status LED. On an M20 router, the LED is located above the optical transceiver on the PIC faceplate. PIC LEDs have four different states, which are described in Table 29. When the PIC comes online, the LED should light steadily with a green light.

Table 29: PIC LED States

Color	State	Description
Red	Fail	The host FPC has detected a PIC failure.
Green	Normal	The port is functioning normally.
Amber	Problem detected; still functioning	To track the problem, use the command-line interface.
None	Not enabled	The port is not enabled, or the PIC is offline.

To check the status of the PICs using the CLI, use the following command:

> user@host> **show chassis fpc pic-status** *fpc-slot*

For more information about using the CLI to get information about the PICs and FPCs, see the JUNOS Internet software manuals.

OC-48 PIC Interoperability

The OC-48 quad-wide PIC used in an M20 router is an intermediate-reach (IR-1) PIC. The OC-48 single-wide PIC used in an M160 router is a short-reach (SR) PIC. These two PICs have different input and output power levels, as shown in Table 30.

Table 30: OC-48 PIC Power Specifications

Interface	Maximum Input (dBm)	Minimum Input (dBm)	Maximum Output (dBm)	Minimum Output (dBm)
SR (M160 router)	–3	–18	–3	–10
IR-1 (M20 and M40 routers)	0	–18	0	–5

The IR-1 interface might transmit more power than the SR PIC can receive without experiencing saturation. To prevent saturation from occurring, you might need to attenuate power at the SR receiver. The IR-1 receiver should not require attenuation, because the SR transmit levels do not exceed the IR-1 receive levels.

To determine the amount of attenuation needed, measure the power level at each receiver. Attenuate the power to bring it within the allowable range. For short lengths of fiber, with fiber and connector loss close to zero, an attenuator of 5 to 10 dB should be sufficient.

Maintain the SSB

To maintain the SSB, follow these guidelines:

■ Periodically check the LEDs on the faceplate of the SSB (see Figure 71 and Table 31) to verify that the SSB is functioning normally.

■ Periodically check the SYSLOG messages on the management console for messages sent by the SSB. During normal operation, the SSB notifies the Routing Engine of any errors it detects.

■ To display SSB status, enter the following CLI command:

    user@host> **show chassis ssb**

Figure 71: SSB LEDs

Debug port   SSB status lights   SSB status lights   SSB offline button
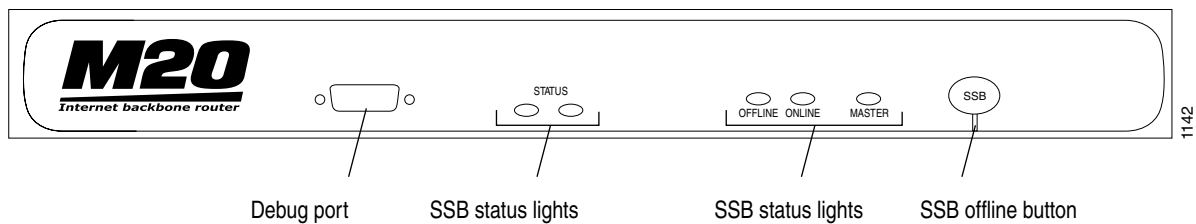
Table 31: SSB LEDs

Color	Label	State	Description
Amber	OFFLINE	On steadily	SSB is offline.
Green	ONLINE	On steadily	SSB processor is running.
Blue	MASTER	On steadily	SSB is master.
Green	STATUS (left)	Blinking	SSB processor is running. Normally, the blinking is faint and becomes bright only when the SSB is processing many exceptions.
Green	STATUS (right)	Flashing	I/O interrupts are occurring.

Replace the SSB

The SSB is hot-pluggable. You can remove and replace it without powering down the system; however this causes major impact to the system. The following functions cannot occur while the SSB is out of the router:

■ Route lookups

■ Monitoring of system components

■ Transfer of exception and control packets

■ FPC resets

To replace the SSB, use the following procedures:

- Remove the SSB on page 162

- Reinstall the SSB on page 163

- Verify That the SSB Is Installed Correctly on page 164

Remove the SSB

The SSB is located at the center front of the card cage. It weighs approximately 3 lb (1.5 kg).

To remove the SSB, follow this procedure (see Figure 72):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Locate the SSB offline switch on the front panel and press and hold down the switch for five seconds to take the SSB offline.

> **⚠ Caution**   If you do not take the SSB offline before removing it, you might lose data.

3. Unscrew the thumbscrews on the left and right sides of the card carrier to unseat the SSB from the midplane.

4. Flip the ends of the two extractor clips, which are adjacent to the thumbscrews, towards the outside edges of the router.

5. Grasp both sides of the card carrier and slide the SSB about three quarters of the way out of the router.

6. Move one of your hands underneath the SSB to support it, and slide it completely out of the chassis.

Figure 72: Remove the SSB

1124

Reinstall the SSB

You reinstall an SSB into the front of the chassis above the craft interface. To reinstall the SSB, follow this procedure (see Figure 73):
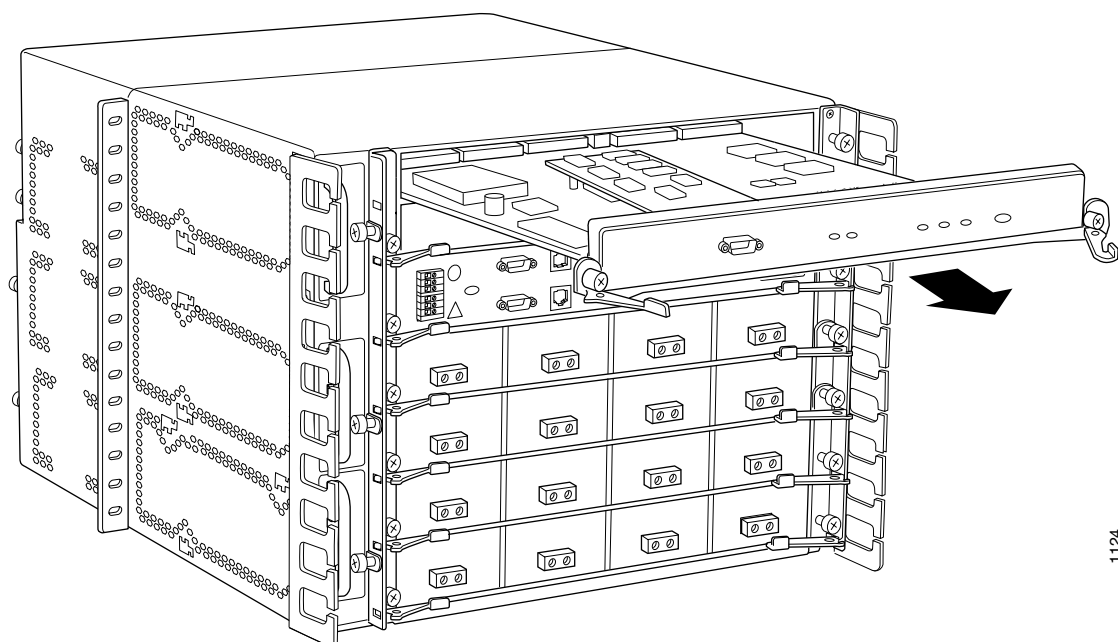
1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Grasp the front of the SSB card carrier with both hands and align the rear of the card carrier with the slide guides on the chassis.

3. Slide the SSB card carrier all the way into the card cage until it contacts the midplane.

4. Flip the extractor clips, located on the left and right sides of the card carrier, towards each other to secure the SSB in place.

5. Tighten the thumbscrews on the left and right sides of the card carrier to seat the SSB.

> To seat the SSB properly, be sure to tighten the screws adequately. If the SSB is not seated properly, it will not function.
>
> **Note**

Figure 73: Reinstall the SSB
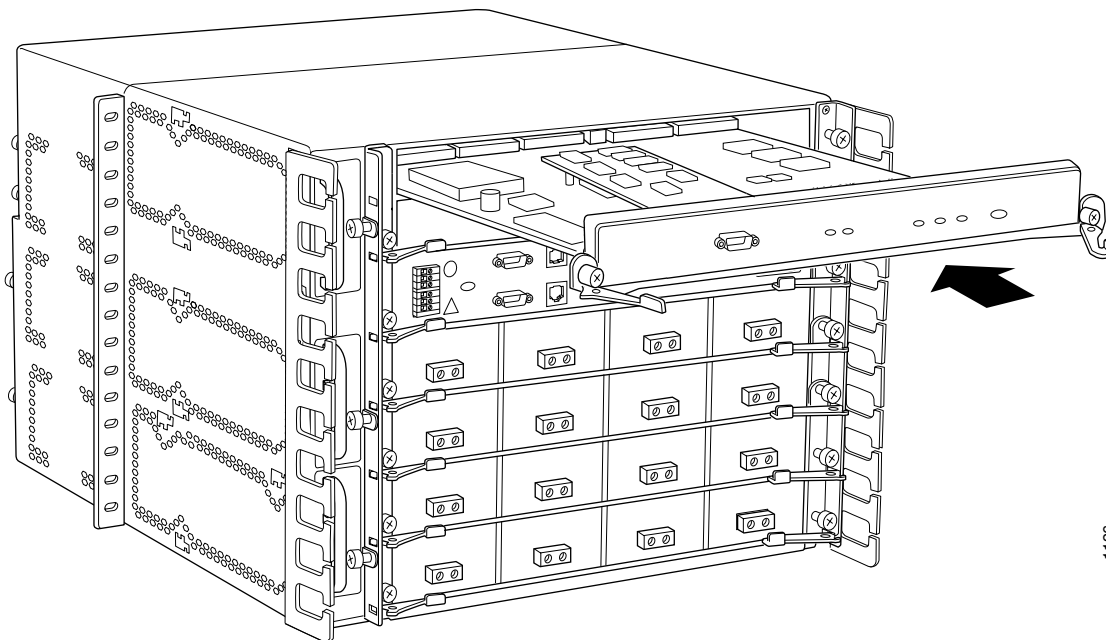
1126

Replace the SSB Battery

The SSB has a lithium battery (CR2030, 3 V) that does not draw power while the system is operational. If the lithium battery needs to be replaced, it is located near the center of the board. It is a small silver disk similar in size to a lithium watch battery.

To replace a battery on the SSB:

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Pry the battery free with your fingers.

3. Insert the new battery in its place.

Verify That the SSB Is Installed Correctly

When the SSB is installed into a running router, it is booted by flash EEPROM.

To verify that the SSB is functioning normally, check the LEDs on its faceplate (see Figure 71 and Table 31). To display information about the SSB, enter the following CLI command:

    user@host> **show chassis ssb**

Maintain the Craft Interface

To maintain the craft interface, follow these guidelines:

■ Periodically check the LEDs on the faceplate of the craft interface (see Figure 71 and Table 31) to verify that the craft interface is functioning normally.

■ Periodically check the **SYSLOG** messages on the management console for messages sent by the craft interface. During normal operation, the craft interface notifies the Routing Engine of any errors it detects.

Figure 74: Craft Interface LEDs
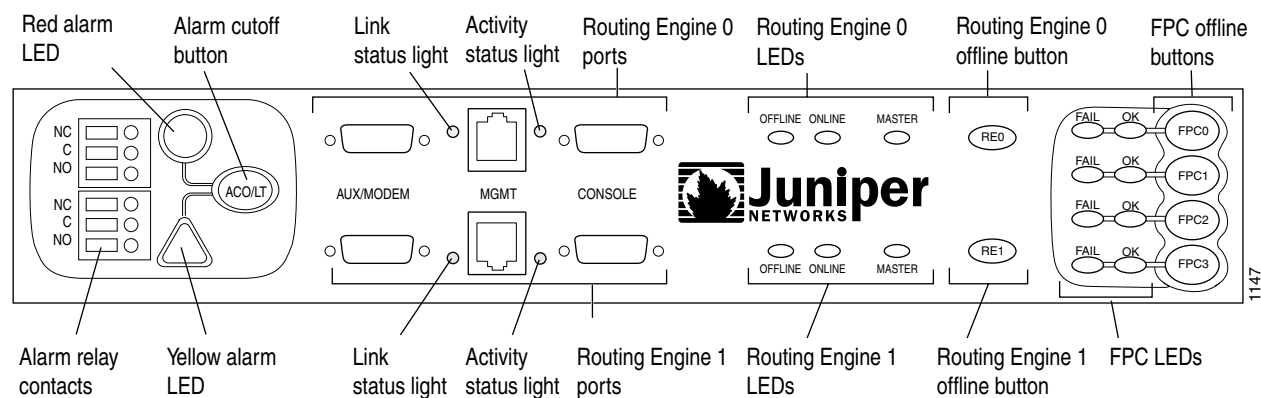
Replace the Craft Interface

The craft interface is hot-removeable and hot-insertable. You can remove and replace these components without powering down the system and disrupting routing functions.

To replace the craft interface, use the following procedures:

■ Remove the Craft Interface on page 166

■ Reinstall the Craft Interface on page 167

■ Verify That the Craft Interface Is Installed Correctly on page 168

Remove the Craft Interface

The craft interface is located at the center front of the card cage. It weighs approximately 3 lb (1.5 kg).

To remove the craft interface, follow this procedure (see Figure 75):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Locate the craft interface offline switch on the front panel and press and hold down the swich for five seconds to take the craft interface offline.

3. Unscrew the thumbscrews on the left and right sides of the card carrier to unseat the craft interface from the midplane.

4. Flip the ends of the two extractor clips, which are adjacent to the thumbscrews, towards the outside edges of the router.

5. Grasp both sides of the card carrier and slide the craft interface about three quarters of the way out of the router.

6. Move one of your hands underneath the craft interface to support it, and slide it completely out of the chassis.

Figure 75: Remove the Craft Interface
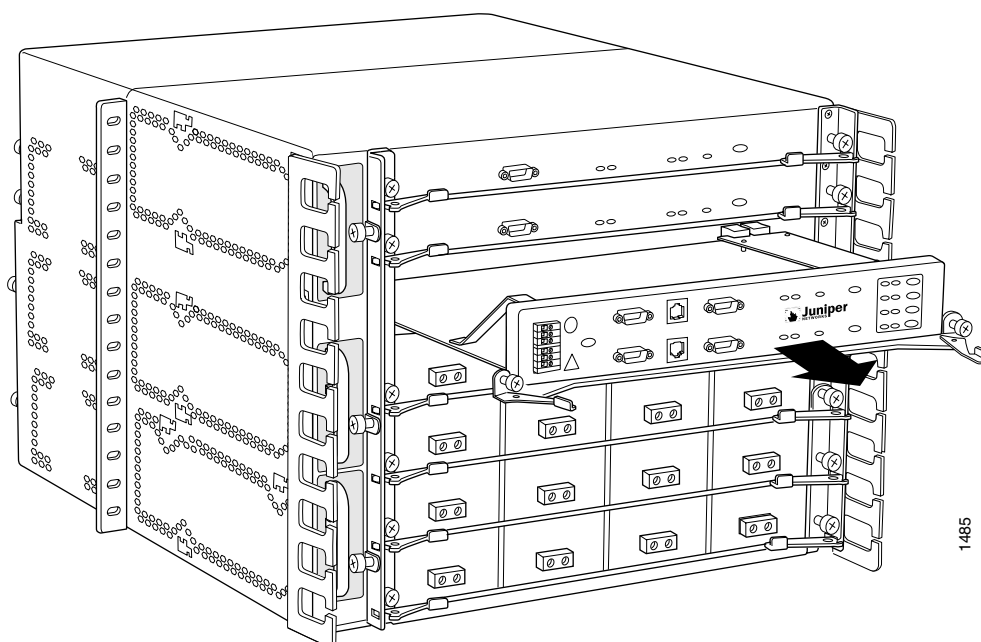
Reinstall the Craft Interface

You reinstall a craft interface into the front of the chassis above the FPCs. To reinstall the craft interface, follow this procedure (see Figure 76):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Grasp the front of the craft interface card carrier with both hands and align the rear of the card carrier with the slide guides on the chassis.

3. Slide the craft interface card carrier all the way into the card cage until it contacts the midplane.

4. Flip the extractor clips, located on the left and right sides of the card carrier, towards each other to secure the craft interface in place.

5. Tighten the thumbscrews on the left and right sides of the card carrier to seat the craft interface.

> To seat the craft interface properly, be sure to tighten the screws adequately. If the craft interface is not seated properly, it will not function.
>
> **Note**

Figure 76: Reinstall the Craft Interface

1486

Verify That the Craft Interface Is Installed Correctly

When the craft interface is installed into a running router, it is booted by flash EEPROM.

To verify that the craft interface is functioning normally, check the LEDs on its faceplate (see Figure 74).

Chapter 13
Maintain and Replace Cables and Connectors

This chapter discusses the following topics related to maintaining and replacing the router's cables and connectors:

- Cable Specifications on page 169

- Maintain the PIC Cables on page 170

- Replace PIC Cables on page 172

- Replace Power Supply Cables on page 174

- Replace Routing Engine External Cables on page 174

Cable Specifications

Table 32, Table 33, and Table 34 list specifications for each type of cable used in the router.

Table 32: Network Cable Specifications

Cable Type	Cable Specification	Supplied	Maximum Length	Connector Specification
DS-3 interface	75-ohm coaxial	One 10-ft length	450 ft (137 m)	Mini BNC
Single-mode interface (fiber)	SC-SC duplex	No	Short reach: 1.25 mi (2 km) Intermediate reach: 9.3 mi (15 km)	SC SC
Multimode interface (fiber)	SC-SC duplex	No	1.25 mi (2 km)	SC
Routing Engine console interface	RS-232 serial	One 6-ft length with DB-9/DB-9 connectors	6 ft (1.83 m)	DB-9
Routing Engine auxiliary interface	RS-232 serial	No	6 ft (1.83 m)	DB-9
Routing Engine Ethernet interface	Category 5 cable or equivalent suitable for 100BaseT operation	One 15-ft length with RJ-45/RJ-45 connectors	328 ft (100 m)	RJ-45

Table 33: DC Power Supply Cable Specifications

| Cable Type	Cable Specification	Supplied	Maximum Length	Other Parts Required	Connector Specification
DC power cable	4 or 6 AWG wire cables	No	None	One locking washer and nut per terminal stud	Cable lug; dual hole, sized to fit 1/4−20 UNC terminal studs at 15.86-mm (0.625-inch) center line
DC grounding cable	4 or 6 AWG wire cables	Locking washers and nuts	None	One locking washer and nut per grounding stud	Cable lug; dual hole, sized to fit 1/4−20 UNC grounding studs at 15.86-mm (0.625-inch) center line

Table 34: AC Power Cable Specifications

Country	Specification	Supplied	Maximum Length	Connector Specification
Australia	240 VAC, 50 Hz AC	Two sets of 2-1/2−meter cords with suitable plugs	None	IEC 320 C19
Europe	230 VAC, 50 Hz AC	Two sets of 2-1/2−meter cords with suitable plugs	None	IEC 320 C19
Italy	220 VAC, 50 Hz AC	Two sets of 2-1/2−meter cords with suitable plugs	None	IEC 320 C19
North America	Plug type: NEMA 6-20 208 VAC, 60 Hz AC	Two sets of 2-1/2−meter cords with suitable plugs	None	IEC 320 C19
United Kingdom	240 VAC, 50 Hz AC	Two sets of 2-1/2−meter cords with suitable plugs	None	IEC 320 C19

Maintain the PIC Cables

To maintain PIC fiber-optic cable properly, follow these guidelines:

- Use the cable management system on the sides of the chassis (see Figure 77) to support cables and prevent cables from dislodging or developing stress points.

- Avoid bending fiber-optic cable beyond its bend radius. An arc smaller than a few inches can damage the cable and cause problems that are difficult to diagnose.

- Anchor fiber-optic cable to avoid stress on the connectors. When attaching fiber to a PIC, be sure to secure the fiber so it is not supporting its own weight as it dangles to the floor. Never let fiber-optic cable hang free from the connector.

- Place excess fiber out of the way in the cable management system. Placing fasteners on the loop help to maintain its shape. Do not allow fastened loops of cable to dangle from the ladder rack because this stresses the cable at the fastening point.

- Label all fiber-optic cables to identify them, labeling each end of the cable the same.

- When you unplug a fiber-optic cable from a PIC, always place a rubber safety plug over the connector.

Figure 77: Front of the Chassis Showing the Cable Management System

Cable management system
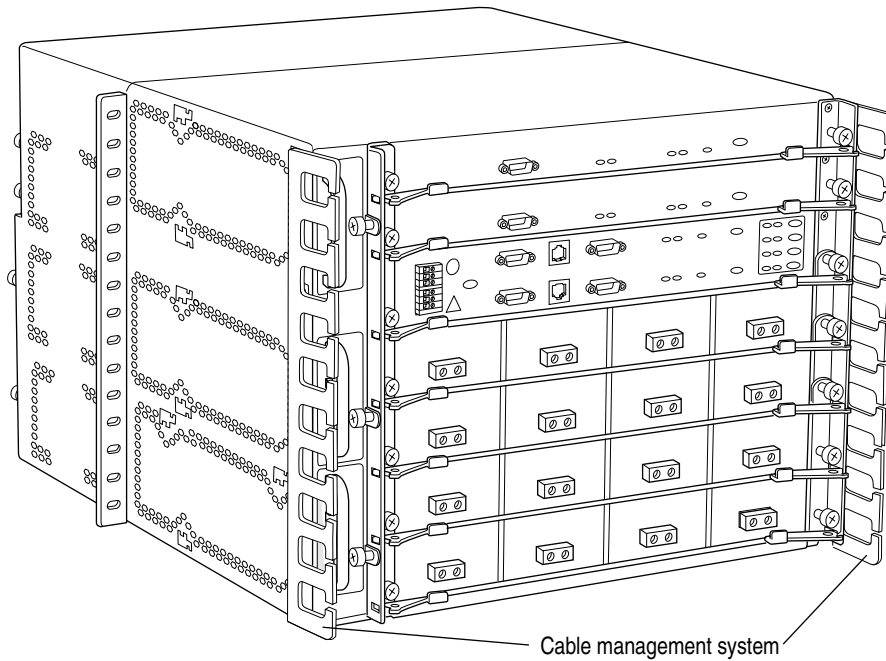
1111-C

Use of ATM Analyzers and Other Optical Equipment

Frequent plugging and unplugging of fibers into or out of optical instruments such as Anritsu or Asynchronous Transfer Mode (ATM) analyzers might damage the instruments, which are expensive to repair. We recommend attaching a short fiber extension to the optical equipment. Any wear and tear due to frequent plugging and unplugging is then absorbed by the short fiber extension, which is easy and inexpensive to replace.

Replace PIC Cables

To replace the fiber-optic SONET/SDH and ATM PIC cables, follow this procedure (see Figure 78). You can complete this procedure without powering down the router.

> **Warning**
>
> If you do not have a replacement rubber plug immediately available, do not unplug the fiber from a PIC. The safety plug keeps the connection clean and prevents accidental exposure to stray light that could damage your eyes.

> **Warning**
>
> Do not look directly into the PICs that are attached to the FPC. PICs that use SONET/SDH or ATM single-mode optical fiber contain laser light sources that can damage your eyes.

1. Identify the appropriate cable to be connected to each PIC (see Table 32).

2. Remove the rubber safety plug from the PIC cable receptacle.

3. Insert the appropriate cable connector into the PIC cable receptacle (see Figure 79).

> **Caution**
>
> Never let fiber-optic cable hang free from the connector. Do not allow fastened loops of cable to dangle from the ladder rack because this stresses the cable at the fastening point.

4. Drape cable over the covered metal hooks in the cable management device on the sides of the chassis (see Figure 77) to prevent cables from dislodging or developing stress points. Secure the fiber so that it is not supporting its own weight as it dangles to the floor. Place excess fiber out of the way in a neatly coiled loop, either on top of the router or in ladder racks above. Placing fasteners on the loop helps to maintain its shape.

Figure 78: Connect Fiber-Optic Cable to a PIC

PIC

Fiber-optic cable

1141
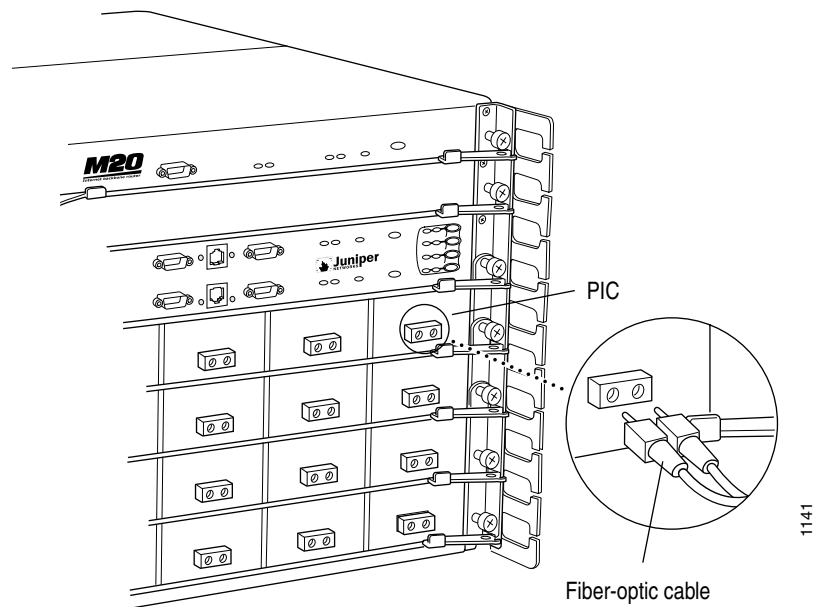
Figure 79: PIC Fiber-Optic Cable Connector

1028
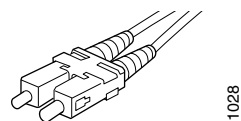
Verify That the PIC Cables Are Installed Correctly

If the cable is installed properly, the PIC port LED is green. Table 35 lists each possible state of each LED. Each port on each PIC has one LED, which is located on the PIC faceplate above the optical transceiver. Each LED has four different states, which are described in Table 35. If the FPC that houses the PIC detects a PIC failure, the FPC informs the SSB, which in turn sends an alarm to the Routing Engine.

Table 35: PIC LED States

Color	State	Description
Red	Fail	The host FPC has detected a PIC failure.
Green	Normal	The port is functioning normally.
Yellow	Problem detected; still functioning	To track the problem, use the CLI.
None	Not enabled	The port is not enabled.

You can check the status of each port on each PIC by observing its LED. You can also check PIC LED status with LCD menus on the craft interface or by using the command-line interface (CLI). Enter the following command to check PIC LED status:

> user@host> **show chassis fpc pic** *slot*

For more information about the CLI commands, see the *JUNOS Internet Software Operational Mode Command Reference.*
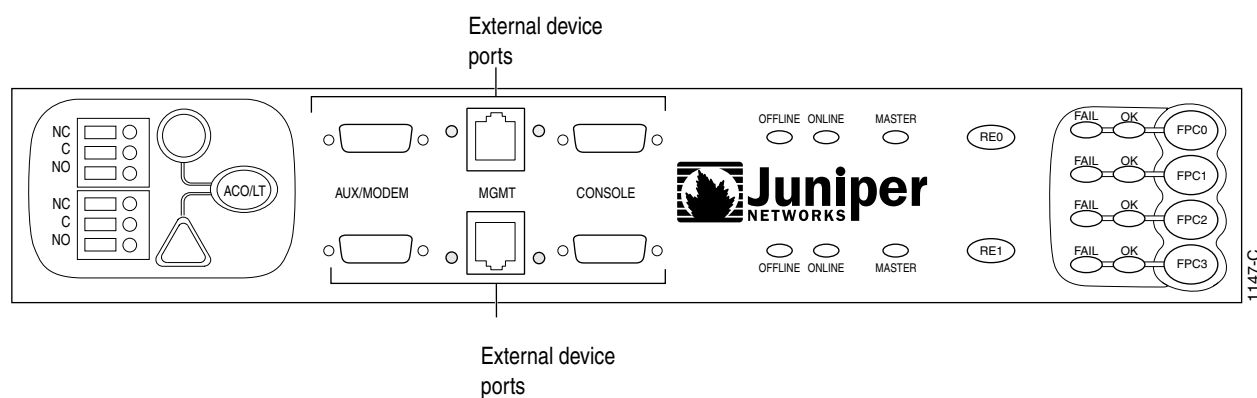
Replace Power Supply Cables

For procedures for replacing AC or DC power supply cables, see the chapter "Maintain and Replace the Power Supplies" on page 133.

Replace Routing Engine External Cables

Follow this procedure to replace cables that connect to external devices (see Figure 80):

- Replace the Management Console Cable on page 175

- Replace the Auxiliary Device Cable on page 175

- Replace the Network Ethernet Cable on page 175

- Replace the Alarm Relay Cables on page 176

Figure 80: Craft Interface Showing Ports to External Devices

External device
ports

```
NC          OFFLINE ONLINE   MASTER              FAIL   OK
 C                                        RE0                  FPC0
NO                                                   FAIL   OK
                                                             FPC1
NC                                                   FAIL   OK
 C      ACO/LT   AUX/MODEM   MGMT   CONSOLE                   FPC2
NO              JUNIPER NETWORKS                      FAIL   OK
                                          RE1                FPC3
             OFFLINE ONLINE   MASTER
```

External device
ports

Replace the Management Console Cable

The Routing Engine management console cable connects to the CONSOLE serial port (see Figure 80). Refer to Table 32 on page 169 for cable specifications.

To connect a management console to the router, follow this procedure:

1. Locate the appropriate cable and connector (see Figure 81).

2. Turn off the console power switch.

3. Plug the female end of the console cable connector into the CONSOLE port on the craft interface.

4. Tighten the screws on the connector.

Figure 81: Console and Auxiliary Serial Port Connector
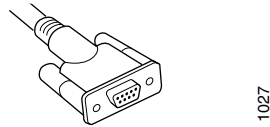
Replace the Auxiliary Device Cable

You can connect a modem, laptop, or other auxiliary device to the router through the AUX/MODEM serial port (see Figure 80). Refer to Table 32 on page 169 for cable specifications.

To connect an auxiliary device, follow this procedure:

1. Locate the appropriate cable and connector (see Figure 81).

2. Turn off the auxiliary device power switch.

3. Plug the female end of the auxiliary device cable connector into the AUX/MODEM port on the craft interface (see Figure 80).

4. Tighten the screws on the connector.

Replace the Network Ethernet Cable

You can connect the router to a network for out-of-band management through the MGMT port on the craft interface (see Figure 80).

To connect the router to a network, follow this procedure:

1. Locate the appropriate cable and connector (see Table 32).

2. Plug one of the Ethernet cable connectors into the MGMT port.

3. Plug the other connector into the network device.

Replace the Alarm Relay Cables

You can connect the router to an external alarm device so that conditions initiating a red or yellow alarm also trigger an external alarm device. Two sets of alarm relay contacts are located on the craft interface (see Figure 80). The upper alarm relay contact is triggered by a red alarm condition and the lower alarm card connector is triggered by a yellow alarm condition.

To connect alarm relay contact cables, follow this procedure:

1. Locate an appropriate length of 14–28 AWG wire for use with the alarm relay terminal blocks.

2. For the first alarm cable, unscrew the small screws on the terminal block and attach the wire to the upper alarm relay contact. This is the contact triggered by a red alarm condition.

3. Attach the other end of the wire to the external device to be activated by a higher-priority alarm.

4. For the second alarm cable, unscrew the small screws on the terminal block and attach the second wire to the lower alarm relay. The lower alarm relay is triggered by a yellow alarm condition.

5. Attach the other end of the second wire to the external device to be activated by a lower-priority alarm.

Chapter 14
Maintain and Replace the Routing Engine

This chapter discusses the following topics about maintaining and replacing Routing Engine components:

- Tools and Parts Required on page 177

- Routing Engine Maintenance on page 177

- Remove and Insert the PC Card on page 180

Tools and Parts Required

You need the following tools and parts to replace Packet Forwarding Engine components:

- Phillips (+) screwdrivers, numbers 1 and 2

- Flat-blade (–) screwdrivers, 3/16-in. and 1/4-in.

- Antistatic mat, placed on a flat, stable surface

- Electrostatic discharge (ESD) grounding wrist strap

Routing Engine Maintenance

To maintain the Routing Engines, follow these guidelines:

- Periodically check the Routing Engine LEDs on the craft interface to make certain the Routing Engines are online and functioning normally.

- Check the state of the Routing Engines, by entering the following command-line interface (CLI) command:

    user@host> **show chassis routing-engine**

To replace a Routing Engine, follow these procedures:

- Remove a Routing Engine on page 178

- Reinstall a Routing Engine on page 179

Remove a Routing Engine

The Routing Engines are located at the rear of the chassis above the power supplies. A Routing Engine weighs approximately 3 lb (1.2 kg).

To remove a Routing Engine, follow this procedure (see Figure 82):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Unscrew the thumbscrews on the left and right sides of the Routing Engine to unseat the Routing Engine from the midplane.

3. Flip the ends of the two extractor clips, which are adjacent to the thumbscrews, towards the outside edges of the router.

4. Grasp both sides of the Routing Engine and slide it about three quarters of the way out of the router.
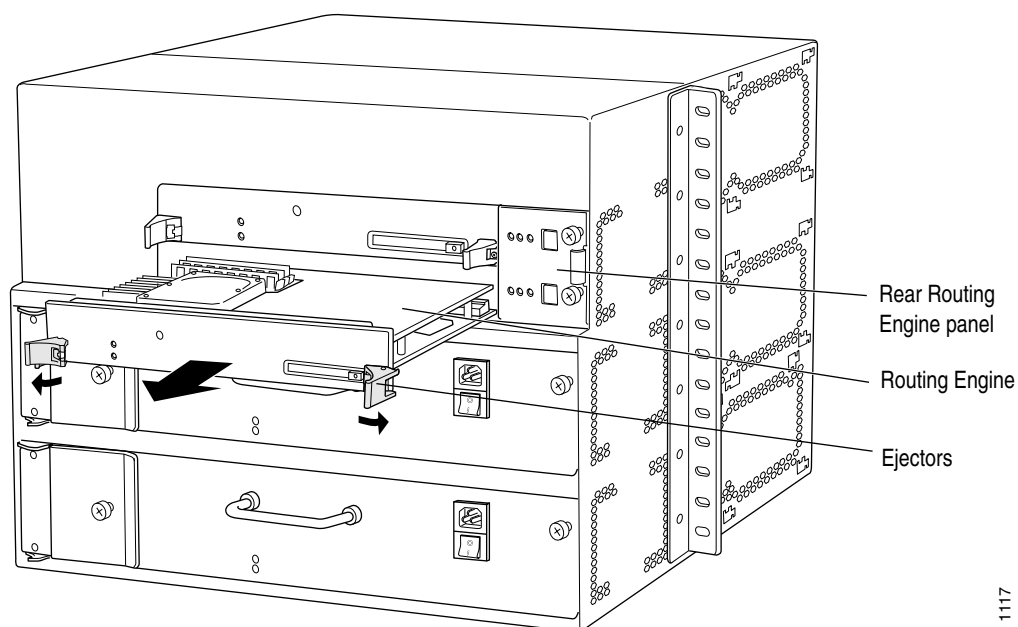
> **!** **Caution**
>
> When removing a Routing Engine, slide the unit out evenly. If you pull one side out faster than the other side, the unit might get lodged in the rail and become damaged.

5. Move one of your hands underneath the housing to support it, and slide the Routing Engine completely out of the chassis.

Figure 82: Remove a Routing Engine

Rear Routing Engine panel

Routing Engine

Ejectors

1117

Reinstall a Routing Engine

To reinstall a Routing Engine in the rear of the chassis above the power supplies, follow this procedure (see Figure 83):

1. Attach an ESD wrist strap to your bare wrist and connect the wrist strap to one of the two ESD points on the chassis.

2. Move one of your hands underneath the Routing Engine to support it and align the rear of the unit with the slide guides inside the chassis.

3. Slide the Routing Engine all the way into the card cage until it connects to the midplane.

> ⚠ **Caution**
>
> When replacing a Routing Engine, slide the unit in evenly. If you push in one side faster than the other, the unit might get lodged in the rail and become damaged.

4. Flip the ends of the two extractor clips, which are adjacent to the thumbscrews, towards the inside of the router. This seats the Routing Engine into the midplane.

5. Using a screwdriver, screw in the thumbscrews on the left and right sides of the Routing Engine.

> **Note**
>
> To seat a Routing Engine properly, be sure to tighten the screws adequately.

Figure 83: Reinstall a Routing Engine

Rear RE panel

Routing engine

Ejectors
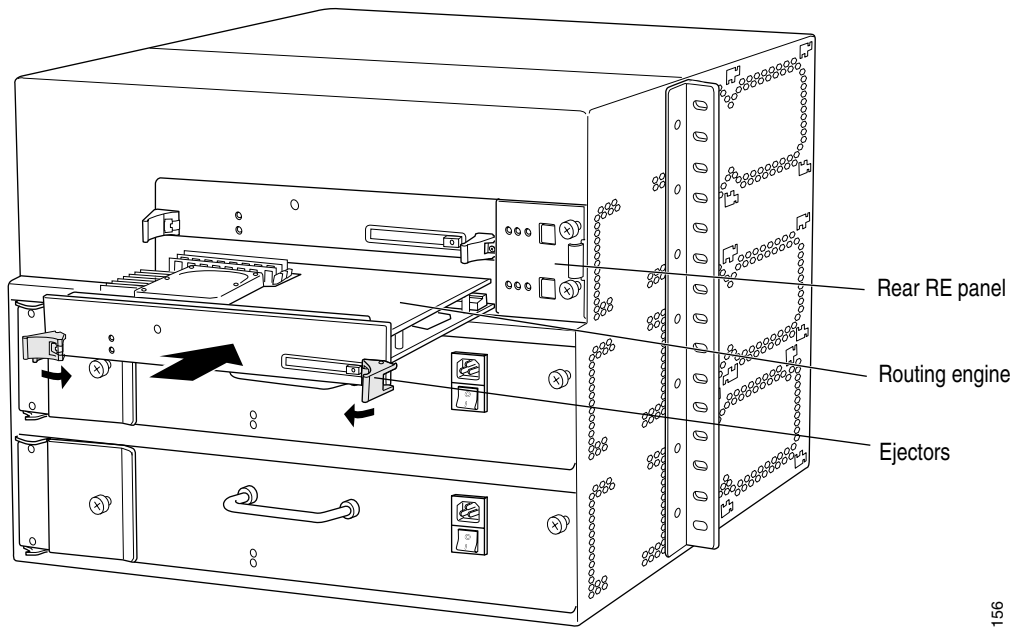
Verify That a Routing Engine Has Been Installed Correctly

To verify that a Routing Engine has been installed properly, check the ROUTING ENGINE LEDs on the craft interface panel after you have installed the Routing Engine. If the Routing Engine is functioning normally, the green ONLINE LED is on. If the amber OFFLINE LED is on instead, the Routing Engine is not functioning normally. Contact your customer service representative if the Routing Engine is not functioning normally.

Remove and Insert the PC Card

The slot labeled PC CARD on the Routing Engine faceplate accepts a Sandisk 110-MB PCMCIA card. The router is shipped with a PC card that contains JUNOS Internet software. You can also copy JUNOS software from the Routing Engine onto a card, for example to create a backup copy of upgrade software that you have obtained from Juniper Networks. Instructions for copying software to a card are available at the Juniper Networks Customer Support Center Web site (http://www.juniper.net/support); follow the link labeled "JUNOS Internet Software Download".

> **Note**
>
> The appearance and position of electronic components or the PC card slot on your Routing Engine might differ from the figures in this section. These differences do not affect Routing Engine functionality.

> **Note** The software on a PC card is loaded only onto the Routing Engine into which the PC card is inserted, and is not automatically copied to the other Routing Engine.

To remove and insert a PC card, perform the following procedures:

- **Remove the PC Card on page 181**

- **Insert the PC Card on page 182**

Remove the PC Card

The PC card is inserted in the slot labeled PC CARD in the Routing Engine faceplate. To remove the PC card, follow this procedure:

1. Remove the rear component cover by loosening the thumbscrews at the corners of the cover and pulling it straight off of the chassis.

2. Press the eject button located to the left side of the PC card slot in the Routing Engine faceplate (see Figure 84). Note that the PC card slot might be located in a different position on your Routing Engine.

3. When the PC card pops partially out of the slot, grasp the card and pull it straight out the rest of the way.

Figure 84: Remove the PC Card

Eject button
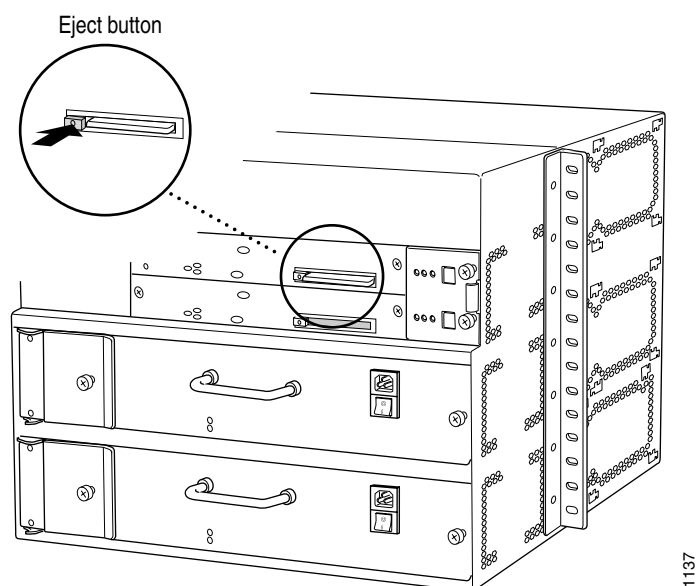
1137

Insert the PC Card

To insert the PC card, follow this procedure:

1. Orient the PC card with the Juniper Networks logo facing in the direction specified on the Routing Engine faceplate. Insert the card into the slot.

2. Press the card firmly all the way into the slot (see Figure 85). Note that the PC card slot might be located in a different position on your Routing Engine.

3. Reinstall the rear component cover and tighten the thumbscrews at the corners of the cover to secure it to the chassis.

Figure 85: Insert the PC Card

Part 4
Troubleshooting

M20 Internet Router Hardware Guide
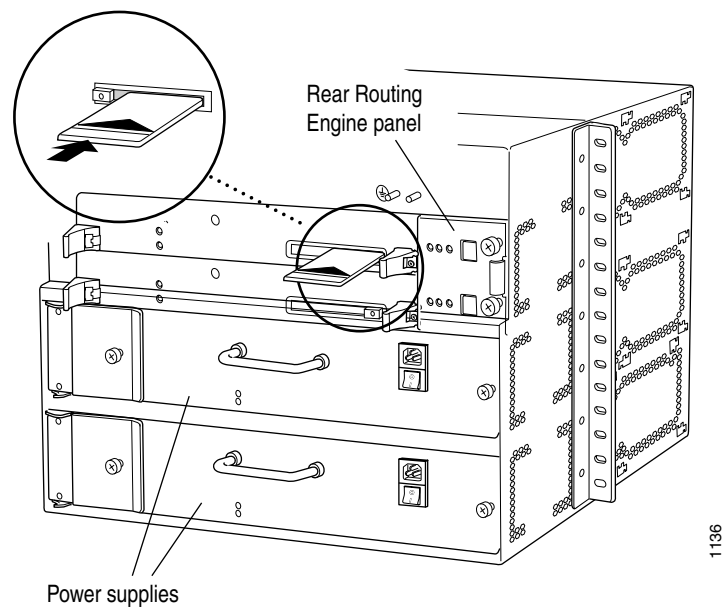
Chapter 15
Troubleshooting Overview

This chapter provides an overview of the following tools that you can use to troubleshoot the router:

- Command-Line Interface on page 185

- System LEDs on page 186

- Display System Alarm Messages on page 186

- Contact Juniper Networks on page 187

The chapters in the troubleshooting section describe general procedures for tracking the source of problems in router components including the cooling system, power supplies, and the Packet Forwarding Engine. If you encounter problems with other router components, including the Routing Engine, contact the Juniper Networks Technical Assistance Center (JTAC) at support@juniper.net or at 1-888-JUNIPER (within the United States) or 408-745-2000 (from outside the United States).

Command-Line Interface

The primary means of controlling and troubleshooting the JUNOS Internet software, routing protocols, network connectivity, and the router hardware is to enter commands from the command-line interface (CLI). The CLI provides commands that let you display information in the routing tables, display routing protocol-specific information, and check network connectivity using the **ping** and **traceroute** commands.

The Routing Engine provides three ports on the craft interface for connecting external management devices to the Routing Engine, providing access to the CLI:

- Console port—Connects a system console with RS-232 cable.

- Auxiliary port—Connects a laptop or modem with RS-232 cable.

- Ethernet management port—Connects the Routing Engine to a management LAN (or any other device that plugs into an Ethernet connection) for out-of-band management of the router. The Ethernet port is 10/100–Mbps autosensing and requires an RJ-45 connector.

For more information about using the CLI, see the JUNOS Internet software documentation.

System LEDs

The craft interface is the collection of mechanisms on the router that allow you to view system LEDs and troubleshoot the router.

System LEDs on the craft interface include the following:

- FPC LEDs—Two LEDs (one green **OK** and one amber **Fail**) indicate the status of each FPC. The two LEDs and a function button are located below each FPC module slot on the craft interface.

- Alarm LEDs—One large red **Alarm** LED and one large amber **Alarm** LED indicate two levels of alarm conditions.

- Routing Engine LEDs—An amber **OFFLINE** LED and a green **ONLINE** LED on the craft interface or rear Routing Engine Panel indicate the status of the Routing Engine.

The following LEDs, which report the status of various system components, are located on the components rather than the craft interface:

- Power supply LEDs—An amber **Fail** LED and a green **OK** LED are located on each power supply faceplate and indicate the status of the power supply.

- PIC LEDs—Each port on each PIC has one LED whose color indicates the status of the port. For more information about these LEDs, see the section "Flexible PIC Concentrators (FPCs)" on page 16.

- SSB LEDs—Three LEDs on the faceplate of the SSB indicate the status of the SSB.

Display System Alarm Messages

The Routing Engine generates two classes of alarm messages:

- Chassis alarms—Caused by problems originating in chassis components such as the cooling system or power supplies. For example, a fan that stops spinning generates a chassis alarm. Table 36 lists the chassis alarm messages.

- Interface alarms—Caused by problems on specific network interfaces present in the router. For example, a fiber-optic connection that is lost generates an interface alarm. Table 37 lists the interface alarm messages.

To display the alarm messages, enter the following CLI command:

user@host> **show chassis alarm**

Table 36: Chassis Alarm Messages

Component	CLI Long Version
Fans	*fan-name* stopped spinning
	fan-name removed
	Too few fans installed or working
Temperature sensors	*temperature-sensor* temperature sensor failed
	A temperature sensor exceeds 54 degrees C
Power supplies	Power supply *x* not providing power
	Power supply *x* 3.3V failed
	Power supply *x* 5V failed
	Power supply *x* 2.5V failed
FPCs	Too many unrecoverable errors
	Too many recoverable errors
Craft Interface	Craft interface not responding

Table 37: SONET Interface Alarm Messages

CLI Long Version
interface-name so-1/2/3 - SONET loss of light
interface-name so-1/2/3 - SONET PLL lock
interface-name so-1/2/3 - SONET loss of frame
interface-name so-1/2/3 - SONET loss of signal
interface-name so-1/2/3 - SONET severely errored frame
interface-name so-1/2/3 - SONET line AIS
interface-name so-1/2/3 - SONET path AIS
interface-name so-1/2/3 - SONET loss of pointer
interface-name so-1/2/3 - SONET bit error rate defect
interface-name so-1/2/3 - SONET bit error rate fault
interface-name so-1/2/3 - SONET line remote defect indicator
interface-name so-1/2/3 - SONET path remote defect indicator
interface-name so-1/2/3 - SONET remote error indicator
interface-name so-1/2/3 - SONET unequipped
interface-name so-1/2/3 - SONET path mismatch

Contact Juniper Networks

If you cannot determine the cause of a problem or need additional assistance, contact the Juniper Networks Technical Assistance Center (JTAC) at **support@juniper.net** or at 1-888-JUNIPER (within the United States) or 408-745-2000 (from outside the United States).

Chapter 16
Troubleshoot the Power Supplies

This chapter provides an overview of troubleshooting the power supplies.

To verify that a power supply is functioning normally, do the following:

■ Check the two LEDs on each power supply faceplate—If the green OK LED lights are on, the power source is good and the power supplies are functional. The green **OK** LED on both the AC and DC power supply lights when the power supply power switch is **ON** and the power supply is receiving source AC or DC power. The red **FAIL** LED lights only if the power supply detects a fault.

■ If the **OK** power supply LED is off, check the **RED ALARM** LED on the craft interface—JUNOS software monitors the system temperature, and if it exceeds a certain limit, the software triggers a **RED ALARM,** a condition that shuts down the power supplies.

> **Note**
>
> If the system temperature exceeds the threshold, the JUNOS software shuts down both power supplies so that no status is displayed. The software also can shut down one of the power supplies for other reasons. In these cases, the redundant power supply assumes the load and you can still view the system status through the CLI.

■ If the **OK** power supply LED is off and no RED ALARM condition exists, verify that the power switch is **ON** (on a DC power supply)—On an AC power supply, verify that the plug is securely in place.

■ Verify that the source DC or AC circuit breaker has the proper current rating—Each power supply in the router must be connected to a separate power source.

■ If the power source is AC, verify that the uninterruptable power supply (UPS) for each power supply is functioning properly.

■ Verify that the power cable or power cord from the power source to the router is not damaged—If the insulation is cracked or broken, immediately replace the cord or cable.

■ Connect the power supply to a different power source with a new power cable—If the power supply **OK** LED still does not light, the power supply is the source of the problem. Replace the existing power supply with a spare as described in the chapter "Maintain and Replace the Power Supplies" on page 133.

- If the **OK** LED on the installed spare lights, the replaced power supply is faulty and you should return it for replacement as described in the chapter "Return the Router or Its Components" on page 203.

- If you cannot determine the cause of the problem or need additional assistance, contact the Juniper Networks Technical Assistance Center (JTAC) at **support@juniper.net** or at 1-888-JUNIPER (within the United States) or 408-745-2000 (from outside the United States).

Chapter 17
Troubleshoot the Cooling System

To troubleshoot the two separate cooling subsystems in the router, follow these procedures (see Figure 86):

- Troubleshoot the Front and Rear Fan Trays on page 192

- Troubleshoot the Power Supply Fans on page 192

Each cooling subsystem maintains a separate air flow, and each is monitored independently for temperature control.

To function properly, the entire cooling system requires an unobstructed air flow and proper clearance around the site as described in the section "Clearance Requirements Outside the Rack" on page 41.

Figure 86: Side View of Air Flow through the Chassis

Front fan trays   Rear fan tray

1241-B

Side of Chassis
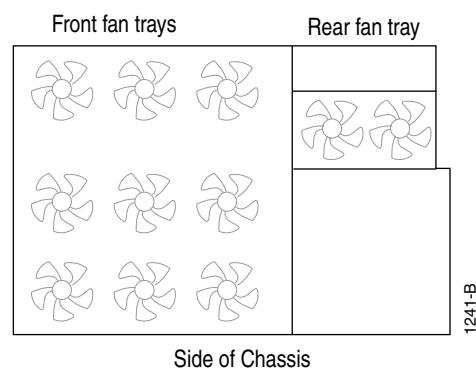
Troubleshoot the Front and Rear Fan Trays

Three front fan trays and one rear fan cool the chassis. The fans operate in unison to maintain an acceptable operating temperature for the Routing Engine and midplane.

To troubleshoot the fan trays, follow these guidelines:

- Various temperature sensors on the router components detect temperatures above the acceptable range—fan failure or an excessive temperature condition triggers the RED ALARM LED on the craft interface and activates alarm relay contacts. If the temperature passes a certain threshold, the JUNOS software turns off the power supplies.

- If one of the fan assemblies fails, determine whether the blades of the fan are rotating—individual blades are not distinguishable when the fan is rotating at normal speeds.

- If the problem is with one of the front fan trays, try moving the fan tray to another bay. If the fan tray does not work in the other bay, it is probably faulty and needs to be replaced. For information about removing and replacing fans, see the chapter "Maintain and Replace Cooling System Components" on page 145.

- If the fan tray works in another bay, there is probably a problem with the power connectivity from the midplane.

Troubleshoot the Power Supply Fans

Two LEDs on each power supply faceplate report power supply status. In addition, a fail condition triggers the red alarm LED on the craft interface. Table 38 describes the power supply LEDs.

Table 38: Power Supply LEDs

Label	Color	State	Description
OK	Green	On steadily	Power supply is functioning normally, input is occurring, outputs are within range, temperature is within range, and fans are operational.
FAIL	Amber	On steadily	Power supply failure.

You can use the CLI to check the status of each power supply and its temperature. Use the following CLI command:

user@host> **show chassis environment**

Chapter 18
Troubleshoot the Packet Forwarding Engine

This chapter discusses the following topics related to troubleshooting components of the Packet Forwarding Engine:

- Troubleshoot the FPCs and Their PICs on page 193

- Troubleshoot the PICs on page 193

- Troubleshoot the SSB on page 194

Troubleshoot the FPCs and Their PICs

As soon as an FPC is seated, the Routing Engine downloads the FPC software, the FPC runs its diagnostics, and the PICs on the FPC card are enabled. You can verify that this process is occurring by checking that the green **OK** LED beneath the FPC is blinking as the FPC starts up. The backplane flushes the entire system memory pool before an FPC is brought online, a process that takes about 200 ms. When the FPC is online, the green **OK** LED beneath the FPC is on steadily.

From that point on, the green FPC **OK** LED is on steadily when the FPC is functioning normally.

To troubleshoot the FPCs, use the following guidelines:

- If the red **FAIL** FPC LED is on, use the LCD screen on the craft interface to check the status of the FPC and the PICs that are plugged into it.

- Make sure the FPC is properly seated in the backplane. Use a screwdriver to check that the screws at the top and bottom of the card carrier are tight.

Troubleshoot the PICs

You can check the status of each port on each PIC by observing its LEDs. Table 39 lists each state of each LED.

Table 39: PIC LED States

Color	State	Description
Red	Fail	The host FPC has detected a PIC failure.
Green	Normal	The port is functioning normally
Yellow	Problem detected; still functioning	To track the problem, use the command-line interface.
None	Not enabled	The port is not enabled.

Troubleshoot the SSB

The SSB is hot-pluggable. When the SSB is removed, all packet forwarding stops immediately and the Routing Engine responds by sending alarms through the Ethernet channel to the management console. When the SSB is replaced, it is rebooted by flash EEPROM.

If you have removed the Routing Engine, the SSB enters a warm shutdown mode and continues its forwarding process for a limited time using a frozen forwarding table. The time limit is determined by a timer in the SSB. If you replace the Routing Engine during the warm shutdown period, the SSB unfreezes its forwarding tables and resumes normal functioning. Otherwise, the SSB shuts itself down.

Figure 87 and Table 40 on page 194 explain the SSB LEDs.
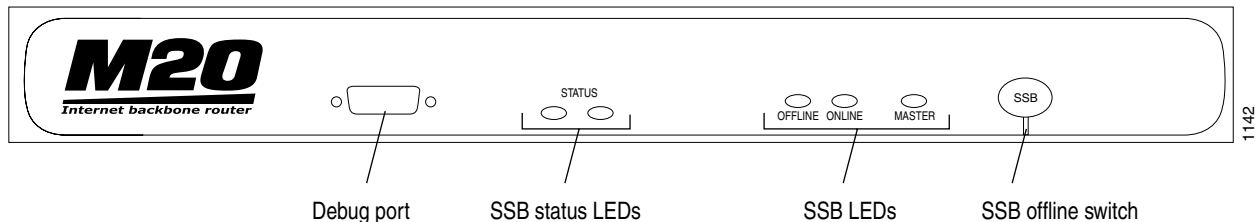
Figure 87: SSB LEDs

Debug port   SSB status LEDs   SSB LEDs   SSB offline switch

Table 40: SSB LEDs

Color	Label	State	Description
Amber	OFFLINE	On steadily	SSB is offline.
Green	ONLINE	On steadily	SSB processor is running.
Blue	MASTER	On steadily	SSB is master.
Green	STATUS (left)	Blinking	SSB processor is running. Normally, the blinking is faint and becomes bright only when the SSB is processing many exceptions.
Green	STATUS (right)	Flashing	I/O interrupts are occurring.

Part 5
Appendixes

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M20 Internet Router Hardware Guide

Appendix A
Cable Connectors and Pinouts

This chapter contains tables that list the pinouts for the following cable connectors on the router:

- Routing Engine Console Port DB-9 Connector on page 197

- Routing Engine Auxiliary Port DB-9 Connector on page 198

- Routing Engine RJ-45 Management Ethernet Port Connector on page 198

- E1 and T1 RJ-48 Cable Pinouts on page 198

Routing Engine Console Port DB-9 Connector

The Routing Engine console DB-9 connector, located on the craft interface, is used to cable the Routing Engine to the management console and is labeled CONSOLE. Table 41 lists the DB-9 connector pinouts.

Table 41: DB-9 Connector Pinout

Pin	Signal	Direction	Description
1	DCD	< –	Carrier Detect
2	RxD	< –	Receive Data
3	TxD	– >	Transmit Data
4	DTR	– >	Data Terminal Ready
5	Ground	—	Signal Ground
6	DSR	< –	Data Set Ready
7	RTS	– >	Ready to Send
8	CTS	< –	Clear to Send
9	RING	< –	Ring Indicator

Routing Engine Auxiliary Port DB-9 Connector

The Routing Engine auxiliary DB-9 connector, located on the craft interface, is used to cable the Routing Engine to a modem or other auxiliary unit, and is labeled **AUX/MODEM**. Table 42 lists the auxiliary DB-9 connector pinout.

Table 42: Auxiliary DB-9 Connector Pinout

Pin	Signal	Direction	Description
1	DCD	< –	Carrier Detect
2	RxD	< –	Receive Data
3	TxD	- >	Transmit Data
4	DTR	– >	Data Terminal Ready
5	Ground	—	Signal Ground
6	DSR	< –	Data Set Ready
7	RTS	– >	Ready to Send
8	CTS	< –	Clear to Send
9	RING	< –	Ring Indicator

Routing Engine RJ-45 Management Ethernet Port Connector

The 10/100-Mbps Ethernet RJ-45 connector (with autosensing), located on the craft interface, is used for out-of-band management of the router and is labeled **MGMT**. Table 43 lists the RJ-45 connector pinout.

Table 43: RJ-45 Connector Pinout

Pin	Signal
1	TX +
2	TX-
3	RX +
4	Termination network
5	Termination network
6	RX-
7	Termination network
8	Termination network

E1 and T1 RJ-48 Cable Pinouts

The E1 and T1 PICs use an RJ-48 cable that is not supplied with the PIC.

> You must use a properly constructed shielded cable to keep the agency approvals in effect.
>
> **Note**

Table 44: RJ-48 Connector to RJ-48 Connector (Straight) Pinout

RJ-48 Pin (on T1/E1 PIC) (Data numbering form)	RJ-48 Pin (Data numbering form)	Signal
1	1	RX, Ring, –
2	2	RX, Tip, +
4	4	TX, Ring, –
5	5	TX, Tip, +
3	3	Shield/Return/Ground
6	6	Shield/Return/Ground
7	No connect	No connect
8	No connect	No connect
9	No connect	No connect
10	No connect	No connect
11	No connect	No connect
12	No connect	No connect
13	No connect	No connect
14	No connect	No connect
15	No connect	No connect

Table 45: RJ-48 Connector to RJ-48 Connector (Crossover) Pinout

RJ-48 Pin (on T1/E1 PIC) (Data numbering form)	RJ-48 Pin (Data numbering form)	Signal
1	4	RX/Ring/– < – – > TX/Ring/–
2	5	RX/Tip/ + < – – > TX/Tip/ +
4	1	TX/Ring/– < – – > RX/Ring/–
5	2	TX/Tip/ + < – – > RX/Tip/ +
3	3	Shield/Return/Ground
6	6	Shield/Return/Ground
7	No connect	No connect
8	No connect	No connect
9	No connect	No connect
10	No connect	No connect
11	No connect	No connect
12	No connect	No connect
13	No connect	No connect
14	No connect	No connect
15	No connect	No connect

Table 46: RJ-48 Connector to DB-15 Connector (Straight) Pinout

RJ-48 Pin (on T1/E1 PIC) (Data numbering form)	DB-15 Pin (Data numbering form)	Signal
1	11	RX/Ring/– <––> RX/Ring/–
2	3	RX/Tip/+ <––> RX/Tip/+
4	9	TX/Ring/– <––> TX/Ring/–
5	1	TX/Tip/+ <––> TX/Tip/+
3	4	Shield/Return/Ground
6	2	Shield/Return/Ground
7	No connect	No connect
8	No connect	No connect
9	No connect	No connect
10	No connect	No connect
11	No connect	No connect
12	No connect	No connect
13	No connect	No connect
14	No connect	No connect
15	No connect	No connect

Table 47: RJ-48 Connector to DB-15 Connector (Crossover) Pinout

RJ-48 Pin (on T1/E1 PIC) (Data numbering form)	DB-15 Pin (Data numbering form)	Signal
1	9	RX/Ring/– <––> TX/Ring/–
2	1	RX/Tip/+ <––> TX/Tip/+
4	11	TX/Ring/– <––> RX/Ring/–
5	3	TX/Tip/+ <––> RX/Tip/+
3	4	Shield/Return/Ground
6	2	Shield/Return/Ground
7	No connect	No connect
8	No connect	No connect
9	No connect	No connect
10	No connect	No connect
11	No connect	No connect
12	No connect	No connect
13	No connect	No connect
14	No connect	No connect
15	No connect	No connect

Appendix B
Fiber-Optic Connector Cleaning

To properly maintain the OC-48 and OC-192 PICs, you must clean the fiber-optic cable transceiver connections before you insert SC cable connectors.

Because of the high sensitivity of the OC-192 PIC receiver, you must keep the PIC connectors clean and free of dust. Small micro-deposits of oil and dust in the canal of the SC connector could cause loss of light, reducing signal power and possibly causing intermittent problems with the optical connection. Figure 88 shows the oil and dust that collects in the SC connector canals.

Figure 88: Microdeposits in the SC Connector Canal
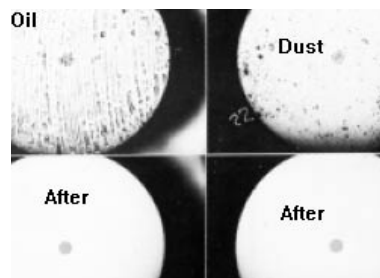
Keep the connectors clean using an appropriate fiber-cleaning device, such as RIFOCS 945/946 Fiber Optic Connector Cleaning System. Follow the directions for the cleaning kit you use. Figure 89 shows the proper cleaning procedure.

Figure 89: Clean the Connectors
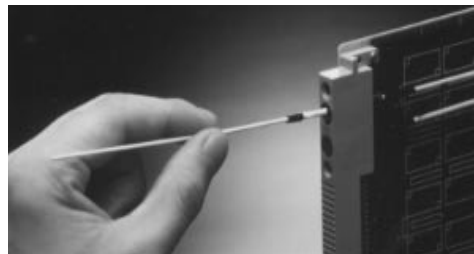
After you have cleaned the optical transceiver area of the fiber-optic PIC, make sure that the fiber-optic cable of the SC connector tip is clean.

To clean the fiber-optic cable SC connection, use only an approved alcohol-free optical cable cleaning kit such as the Cletop - Cletop Reel-Type Cleaner – Part# CLETOP-RL. Follow the directions for the cleaning kit you use. Figure 90 shows the cable cleaning kit.

Figure 90: Optical Cable Cleaning Kit

Appendix C
Return the Router or Its Components

This chapter discusses the following topics related to returning parts for repair or replacement:

- Return Procedure on page 203

- Locate Component Serial Numbers on page 204

- Pack the Router for Shipment on page 207

- Pack Components for Shipment on page 207

Return Procedure

For product problems or technical support issues, contact the Juniper Networks Technical Assistance Center (JTAC) at **support@juniper.net**, or at 1-888-314-JTAC (within the United States) or 408-745-2121 (from outside the United States).

When you need to return a component, follow this procedure:

1. You must obtain a Return Materials Authorization Number (RMA) before returning a product for repair or replacement. When requesting an RMA, please provide the following information:

    - Model number and serial number of unit

    - Requester name and telephone and fax numbers

    - Ship-to address, including contact name and phone number

    - Description of the failure

    When your RMA request is validated, an RMA is issued for the return of the inoperative unit.

2. Locate the serial number of the component you are replacing. See "Locate Component Serial Numbers" on page 204 for more information.

3. Pack the router or router components for shipment using the procedure as described in "Pack the Router for Shipment" on page 207 or "Pack Components for Shipment" on page 207.

Locate Component Serial Numbers

Before returning a router component to Juniper Networks, you must find the serial number to include on the RMA.

To list all the chassis components and their serial numbers, enter the following command-line interface (CLI) command:

user@host> **show chassis hardware**

You can also find the serial numbers on the components. The following sections describe the physical location of the serial number on each component of the router.

Serial Number Tags

On most components, the serial number appears as a small rectangular tag attached to the component (see Figure 91).

Figure 91: Serial Number Tags

FPC Serial Number Tag

The serial number tag is located on back of the right side of the FPC (see Figure 92).

Figure 92: Serial Number Tag on FPC
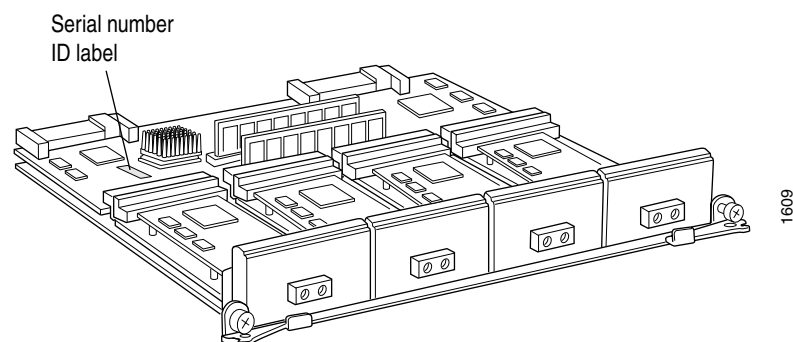
PIC Serial Number Tag

The serial number tag is located on the left side of the PIC (see Figure 93), when the PIC is horizontally oriented (as it would be installed in the router).

Figure 93: Serial Number Tag on PIC
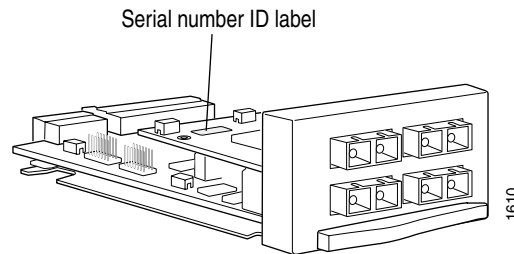
Routing Engine Serial Number Tag

The serial number tag is located on the right side of the top of the Routing Engine (see Figure 94). Note that there may be multiple tags on the Routing Engine: the tag marked "Teknor Silicon Serial ID" contains the correct serial number.

To determine the correct serial number, use the **show chassis routing-engine bios** command. If the BIOS is below 1.2, use the upper serial number. If the BIOS is 1.2 or above, use the lower serial number.

Figure 94: Serial Number Tag on Routing Engine
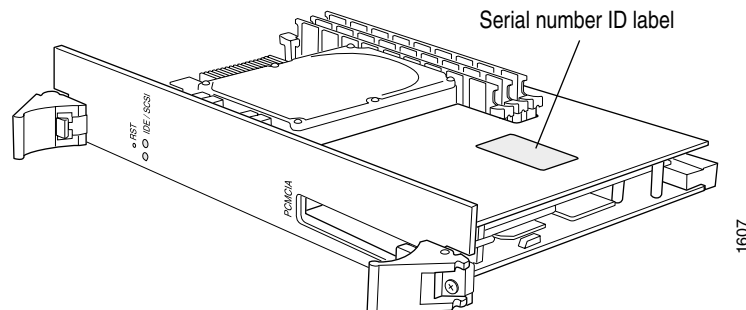
Craft Interface Serial Number Tag

The serial number is located on the front of the craft interface panel (see Figure 95).

Figure 95: Serial Number Tag on Craft Interface

Serial number ID label
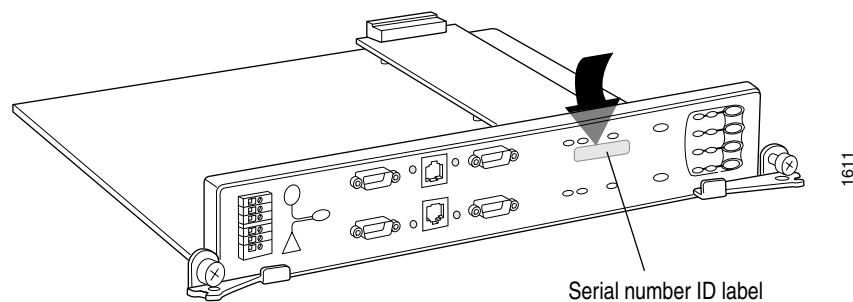
Power Supply Serial Number Tag

The serial number tag is located on the right side of the back of the power supply (see Figure 96).

Figure 96: Serial Number Tag on Power Supply Faceplate

Serial number ID label

-48V DC
RTN
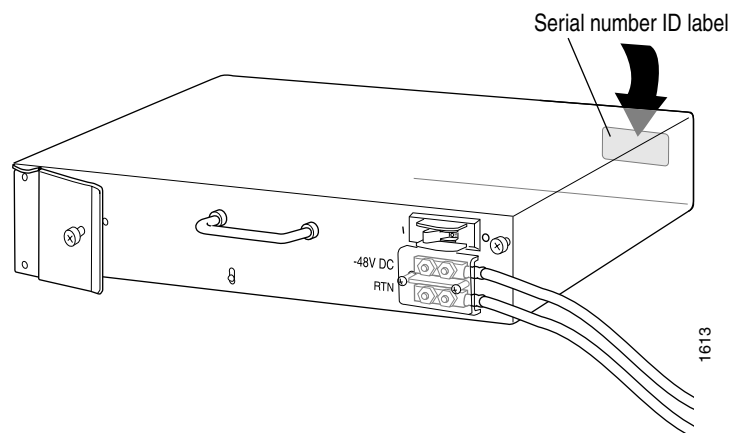
Pack the Router for Shipment

To pack the router for shipment follow this procedure:

1. Retrieve the packing box, pallet, packing materials, and strapping that contained your router when it was shipped.

2. Power down the router and remove the power supplies.

3. Remove the cables to all external devices.

4. Remove the chassis from the rack.

   - If you are moving the router using a mechanical lift, place the lift under the chassis to secure it, disconnect the router from the rack, and move it to the pallet.

   - If you are moving the router manually, you must first remove the components as described in "Remove Components from the Chassis" on page 98, disconnect the router from the rack, move it to the pallet, then reinstall the components as described in "Reinstall Components into the Chassis" on page 109.

5. Place the chassis on the pallet and bolt it to the pallet.

6. Replace the packing foam on top of the chassis.

7. Place the crate cover over the chassis and foam.

Pack Components for Shipment

To pack and ship individual router components, follow these guidelines:

- When you return components, make sure they are adequately protected with packing materials and packed so that the pieces are prevented from moving around inside the carton. Use the original shipping materials if they are available.

- Place individual boards in electrostatic bags.

> ⚠ **Caution**
>
> Do not stack any of the Packet Forwarding Engine components.

Appendix D
Glossary

A

AAL	ATM adaptation layer. A series of protocols enabling asynchronous transfer mode (ATM) to be compatible with virtually all commonly used standards for voice, data, image, and video.
active route	Route chosen from all routes in the routing table to reach a destination. Active routes are installed into the forwarding table.
add/drop multiplexer	*See ADM.*
Address Resolution Protocol	*See ARP.*
adjacency	Portion of the local routing information that pertains to the reachability of a single neighbor over a single circuit or interface.
ADM	Add/drop multiplexer. SONET functionality that allows lower-level signals to be dropped from a high-speed optical connection.
aggregation	Combination of groups of routes that have common addresses into a single entry in the routing table.
ANSI	American National Standards Institute. The United States' representative to ISO.
APS	Automatic Protection Switching. Technology used by SONET ADMs to protect against circuit faults between the ADM and a router and to protect against failing routers.
area	Routing subdomain that maintains detailed routing information about its own internal composition and that maintains routing information that allows it to reach other routing subdomains. In IS-IS, an area corresponds to a Level 1 subdomain. In IS-IS and OSPF, a set of contiguous networks and hosts within an autonomous system that have been administratively grouped together.
area border router	Router that belongs to more than one area.
ARP	Address Resolution Protocol. Protocol for mapping IP addresses to MAC addresses.
AS	Autonomous system. Set of routers under a single technical administration. Each AS normally uses a single interior gateway protocol (IGP) and metrics to propagate routing information within the set of routers. Also called *routing domain*.
AS boundary router	In OSPF, routers that exchange routing information with routers in other ASs.

AS external link advertisements	OSPF link-state advertisement sent by AS boundary routers to describe external routes that they know. These link-state advertisements are flooded throughout the AS (except for stub areas).
AS path	In BGP, the route to a destination. The path consists of the AS numbers of all routers a packet must go through to reach a destination.
ASIC	Application-specific integrated circuit. Specialized processors that perform specific functions on the router.
ATM	Asynchronous Transfer Mode. A high-speed multiplexing and switching method utilizing fixed-length cells of 53 octets to support multiple types of traffic.
atomic	Smallest possible operation. An atomic operation must be performed entirely or not at all. For example, if machine failure prevents a transaction from completion, the system is rolled back to the start of the transaction, with no changes taking place.
Automatic Protection Switching	*See APS.*
autonomous system	*See AS.*
autonomous system boundary router	In OSPF, routers that exchange routing information with routers in other autonomous systems.
autonomous system external link advertisements	OSPF link-state advertisement sent by autonomous system boundary routers to describe external routes that they know. These link-state advertisements are flooded throughout the autonomous system (except for stub areas).
autonomous system path	In BGP, the route to a destination. The path consists of the autonomous system numbers of all the routers a packet must pass through to reach a destination.

B

backbone area	In OSPF, an area that consists of all networks in area ID 0.0.0.0, their attached routers, and all area border routers.
backplane	On an M40 router, component of the Packet Forwarding Engine that distributes power, provides signal connectivity, manages shared memory on FPCs, and passes outgoing data cells to FPCs.
bandwidth	Measure of the communications capacity or data-transmission rate of a circuit.
Bellcore	Bell Communications Research. Research and development organization created after the divestiture of the Bell System. Bellcore was created and is supported by the regional bell holding companies (RBHCs), which own the RBOCs.
BERT	Bit error rate test. A test that can be run on a T3 interface to determine whether it is operating properly.
BGP	Border Gateway Protocol. Exterior gateway protocol used to exchange routing information among routers in different autonomous systems.
bit error rate test	*See BERT.*
BITS	Building Integrated Timing Source. Dedicated timing source that synchronizes all equipment in a particular building.

Border Gateway Protocol	*See BGP.*
broadcast	Operation of sending network traffic from one network node to all other network nodes.
bundle	Collection of software that makes up a JUNOS software release.

C

CCC	Circuit cross-connect. A JUNOS software feature that allows you to configure transparent connections between two circuits, where a circuit can be a Frame Relay DLCI, an ATM VC, a PPP interface, a Cisco HDLC interface, or an MPLS label-switched path (LSP).
CE device	Customer edge device. Router or switch in the customer's network that is connected to a service provider's (SP's) provider edge (PE) router and participates in a Layer 3 VPN.
CFM	Cubic feet per minute. Measure of fan speed.
channel service unit	*See CSU/DSU.*
CIDR	Classless interdomain routing. A method of specifying Internet addresses in which you explicitly specify the bits of the address to represent the network address instead of determining this information from the first octet of the address.
CIP	Connector Interface Panel. On an M160 router, the panel that contains connectors for the Routing Engines, BITS interfaces, and alarm relay contacts.
circuit cross-connect	*See CCC.*
class of service	*See CoS.*
CLEC	(pronounced see-lek) Competitive Local Exchange Carrier. Company that competes with the already established local telecommunications business by providing its own network and switching.
CLEI	Common language equipment identifier. Inventory code used to identify and track telecommunications equipment.
CLI	Command-line interface. Interface provided for configuring and monitoring the routing protocol software.
client peer	In a BGP route reflection, a member of a cluster that is not the route reflector. *See also nonclient peer*.
CLNP	Connectionless Network Protocol. ISO-developed protocol for OSI connectionless network service. CLNP is the OSI equivalent of IP.
cluster	In BGP, a set of routers that have been grouped together. A cluster consists of one system that acts as a route reflector, along with any number of client peers. The client peers receive their route information only from the route reflector system. Routers in a cluster do not need to be fully meshed.
community	In BGP, a group of destinations that share a common property. Community information is included as one of the path attributes in BGP update messages.
confederation	A group of BGP systems that appears to external autonomous systems to be a single autonomous system.

constrained path	In traffic engineering, a path determined using RSVP signaling and constrained using CSPF. The ERO carried in the packets contains the constrained path information.
core	The central backbone of the network.
CoS	Class of service. A group of privileges and features assigned to a particular service.
CPE	Customer premises equipment. Telephone or other service provider equipment located at a customer site.
craft interface	Mechanisms used by a Communication Workers of America craftsperson to operate, administer, and maintain equipment or provision data communications. On a Juniper Networks router, the craft interface allows you to view status and troubleshooting information and perform system control functions.
CSNP	Complete sequence number PDU. Packet that contains a complete list of all the LSPs in the IS-IS database.
CSPF	Constrained Shortest Path First. An MPLS algorithm that has been modified to take into account specific restrictions when calculating the shortest path across the network.
CSU/DSU	Channel service unit/data service unit. Channel service unit connects a digital phone line to a multiplexer or other digital signal device. Data service unit connects a DTE to a digital phone line.
customer edge device	*See CE device.*

D

daemon	Background process that performs operations on behalf of the system software and hardware. Daemons normally start when the system software is booted, and they run as long as the software is running.
damping	Method of reducing the number of update messages sent between BGP peers, thereby reducing the load on these peers without adversely affecting the route convergence time for stable routes.
data circuit-terminating equipment	*See DCE.*
data-link connection identifier	*See DLCI.*
data service unit	*See CSU/DSU.*
Data Terminal Equipment	*See DTE.*
dcd	The JUNOS software interface process.
DCE	Data circuit-terminating equipment. RS-232-C device, typically used for a modem or printer, or a network access and packet switching node.
default address	Router address that is used as the source address on unnumbered interfaces.
denial of service	*See DoS.*

dense wavelength-division multiplexing	*See DWDM.*
designated router	In OSPF, a router selected by other routers that is responsible for sending link-state advertisements that describe the network, which reduces the amount of network traffic and the size of the routers' topological databases.
destination prefix length	Number of bits of the network address used for host portion of a CIDR IP address.
DHCP	Dynamic Host Configuration Protocol. Allocates IP addresses dynamically so that they can be reused when they are no longer needed.
Dijkstra algorithm	*See SPF.*
DIMM	Dual inline memory module. 168-pin memory module that supports 64-bit data transfer.
direct routes	*See interface routes.*
DLCI	Data-link connection identifier. Identifier for a Frame Relay virtual connection (also called a logical interface).
DoS	Denial of service. System security breach in which network services become unavailable to users.
DRAM	Dynamic random-access memory. Storage source on the router that can be accessed quickly by a process.
drop profile	Drop probabilities for different levels of buffer fullness that are used by RED to determine from which queue to drop packets.
DSU	Data service unit. A device used to connect a DTE to a digital phone line. Converts digital data from a router to voltages and encoding required by the phone line.
DTE	Data Terminal Equipment. RS-232-C interface that a computer uses to exchange information with a serial device.
DVMRP	Distance Vector Multicast Routing Protocol. Distributed multicast routing protocol that dynamically generates IP multicast delivery trees using a technique called reverse path multicasting (RPM) to forward multicast traffic to downstream interfaces.
DWDM	Dense wavelength-division multiplexing. Technology that enables data from different sources to be carried together on an optical fiber, with each signal carried on its own serperate wavelength.
Dynamic Host Configuration Protocol	*See DHCP.*

E

EBGP	External BGP. BGP configuration in which sessions are established between routers in different ASs.
ECSA	Exchange Carriers Standards Association. A standards organization created after the divestiture of the Bell System to represent the interests of interexchange carriers.

edge router A router located at the beginning or end of a label-switching tunnel. When at the beginning of a tunnel, an edge router applies labels to new packets entering the tunnel. When at the end of a tunnel, the edge router removes labels from packets exiting the tunnel. See also *MPLS*.

EGP Exterior gateway protocol, such as BGP.

egress router Last router in a label-switched path (LSP). *See also ingress router.*

EIA Electronic Industries Association. A United States trade group that represents manufacturers of electronics devices and sets standards and specifications.

EMI Electromagnetic interference. Any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics or electrical equipment.

end system Network entity that sends and receives packets.

ERO Explicit Route Object. Extension to RSVP that allows an RSVP PATH message to traverse an explicit sequence of routers that is independent of conventional shortest-path IP routing.

explicit path *See signaled path*.

Explicit Route Object *See ERO.*

export To place routes from the routing table into a routing protocol.

external BGP *See EBGP.*

external metric A cost included in a route when OSPF exports route information from external autonomous systems. There are two types of external metrics: Type 1 and Type 2. Type 1 external metrics are equivalent to the link-state metric; that is, the cost of the route, used in the internal autonomous system. Type 2 external metrics are greater than the cost of any path internal to the autonomous system.

F

fast reroute Mechanism for automatically rerouting traffic on an LSP if a node or link in an LSP fails, thus reducing the loss of packets traveling over the LSP.

FEAC Far-end alarm and control. T3 signal used to send alarm or status information from the far-end terminal back to the near-end terminal and to initiate T3 loopbacks at the far-end terminal from the near-end terminal.

FEB Forwarding Engine Board. In M5 and M10 routers, provides route lookup, filtering, and switching to the destination port.

filter *See policy.*

flap damping *See damping.*

flapping *See route flapping.*

Flexible PIC Concentrator *See FPC.*

Forwarding Engine Board *See FEB.*

forwarding information base   *See forwarding table.*

forwarding table   JUNOS software forwarding information base. The JUNOS routing protocol process installs active routes from its routing tables into the Routing Engine forwarding table. The kernel copies this forwarding table into the Packet Forwarding Engine, which is responsible for determining which interface transmits the packets.

FPC   Flexible PIC Concentrator. An interface concentrator on which PICs are mounted. An FPC inserts into a slot in a Juniper Networks router. *See also PIC.*

FRU   Field-replaceable unit. Router components that customers can replace onsite.

group   A collection of related BGP peers.

HDLC   High-level data link control. An International Telecommunication Union (ITU) standard for a bit-oriented datalink-layer protocol on which most other bit-oriented protocols are based.

hold time   Maximum number of seconds allowed to elapse between the time a BGP system receives successive keepalive or update messages from a peer.

host module   On an M160 router, provides routing and system management functions of the router. Consists of the Routing Engine and Miscellaneous Control Subsystem (MCS).

IANA   Internet Assigned Numbers Authority. Regulatory group that maintains all assigned and registered Internet numbers, such as IP and multicast addresses. *See also NIC.*

IBGP   Internal BGP. BGP configuration in which sessions are established between routers in the same ASs.

ICMP   Internet Control Message Protocol. Used in router discovery, ICMP allows router advertisements that enable a host to discover addresses of operating routers on the subnet.

IDE   Type of hard disk on the Routing Engine.

IEC   International Electrotechnical Commission. *See ISO.*

IEEE   Institute of Electronic and Electrical Engineers. International professional society for electrical engineers.

IETF   Internet Engineering Task Force. International community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet.

IGMP   Internet Group Membership Protocol. Used with multicast protocols to determine whether group members are present.

IGP   Interior gateway protocol, such as IS-IS, OSPF, and RIP.

import   To install routes from the routing protocols into a routing table.

ingress router   First router in a label-switched path (LSP). *See also egress router.*

inter-AS routing	Routing of packets among different ASs. *See also EBGP.*
intercluster reflection	In a BGP route reflection, the redistribution of routing information by a route reflector system to all nonclient peers (BGP peers not in the cluster). See also *route reflection*.
interface routes	Routes that are in the routing table because an interface has been configured with an IP address. Also called *direct routes*.
intermediate system	Network entity that sends and receives packets and that can also route packets.
internal BGP	*See IBGP.*
intra-AS routing	The routing of packets within a single AS. *See also IBGP.*
IP	Internet Protocol. The protocol used for sending data from one point to another on the Internet.
IS-IS	Intermediate System-to-Intermediate System protocol. Link-state, interior gateway routing protocol for IP networks that also uses the shortest-path first (SPF) algorithm to determine routes.
ISO	International Organization for Standardization. Worldwide federation of standards bodies that promotes international standardization and publishes international agreements as International Standards.
ISP	Internet service provider. Company that provides access to the Internet and related services.
ITU	International Telecommunications Union (formerly known as the CCITT). Group supported by the United Nations that makes recommendations and coordinates the development of telecommunications standards for the entire world.

J

jitter	Small random variation introduced into the value of a timer to prevent multiple timer expirations from becoming synchronized.

K

kernel forwarding table	*See forwarding table.*

L

label	20-bit unsigned integer in the range 0 through 1048575, used to identify a packet traveling along an LSP.
label-switched path (LSP)	Sequence of routers that cooperatively perform MPLS operations for a packet stream. The first router in an LSP is called the *ingress router,* and the last router in the path is called the *egress router.* An LSP is a point-to-point, half-duplex connection from the ingress router to the egress router. (The ingress and egress routers cannot be the same router.)
label switching	*See MPLS.*
label-switching router	*See LSR.*
link	Communication path between two neighbors. A link is *up* when communication is possible between the two end points.
link-state PDU (LSP)	Packets that contain information about the state of adjacencies to neighboring systems.

local preference	Optional BGP path attribute carried in internal BGP update packets that indicates the degree of preference for an external route.
loose	In the context of traffic engineering, a path that can use any route or any number of other intermediate (transit) points to reach the next address in the path. (Definition from RFC 791, modified to fit LSPs.)
LSP	*See label-switched path (LSP) and link-state PDU (LSP).*
LSR	Label-switching router. A router on which MPLS and RSVP are enabled and is thus capable of processing label-switched packets.

M

martian address	Network address about which all information is ignored.
mask	*See subnet mask.*
MBGP	Multiprotocol BGP. An extension to BGP that allows you to connect multicast topologies within and between BGP ASs.
MBone	Internet multicast backbone. An interconnected set of subnetworks and routers that support the delivery of IP multicast traffic. The MBone is a virtual network that is layered on top of sections of the physical Internet.
MCS	Miscellaneous Control Subsystem. On an M160 router, provides control and monitoring functions for router components and SONET clocking for the router.
MED	Multiple exit discriminator. Optional BGP path attribute consisting of a metric value that is used to determine the exit point to a destination when all other factors in determining the exit point are equal.
mesh	Network topology in which devices are organized in a manageable, segmented manner with many, often redundant, interconnections between network nodes.
MIB	Management Information Base. Definition of an object that can be managed by SNMP.
midplane	Forms the rear of the PIC cage on M5 and M10 routers and the FPC card cage on M20 and M160 routers. Provides data transfer, power distribution, and signal connectivity.
Miscellaneous Control Subsystem	*See MCS.*
MPLS	Multiprotocol Label Switching. Mechanism for engineering network traffic patterns that functions by assigning to network packets short labels that describe how to forward them through the network. Also called *label switching. See also traffic engineering.*
MTBF	Mean time between failure. Measure of hardware component reliability.
MTU	Maximum transfer unit. Limit on segment size for a network.
multicast	Operation of sending network traffic from one network node to multiple network nodes.
multiprotocol BGP	*See MBGP.*
Multiprotocol Label Switching	*See MPLS.*

N **neighbor** Adjacent system reachable by traversing a single subnetwork. An immediately adjacent router. Also called a *peer*.

NET Network entity title. Network address defined by the ISO network architecture and used in CLNS-based networks.

network layer reachability information *See NLRI.*

network link advertisement An OSPF link-state advertisement flooded throughout a single area by designated routers to describe all routers attached to the network.

Network Time Protocol *See NTP.*

NIC Network Information Center. Internet authority responsible for assigning Internet-related numbers, such as IP addresses and autonomous system numbers. See also *IANA*.

NLRI Network layer reachability information. Information that is carried in BGP packets and is used by MBGP.

nonclient peer In a BGP route reflection, a BGP peer that is not a member of a cluster. See also *client peer*.

not-so-stubby area *See NSSA.*

NSAP Network service access point. Connection to a network that is identified by a network address.

n-selector Last byte of an nonclient peer address.

NSSA Not-so-stubby area. In OSPF, a type of stub area in which external routes can be flooded.

NTP Network Time Protocol. Protocol used to synchronize computer clock times on a network.

O **OC** Optical Carrier. In SONET, Optical Carrier levels indicate the transmission rate of digital signals on optical fiber.

OSI Open System Interconnection. Standard reference model for how messages are transmitted between two points on a network.

OSPF Open Shortest Path First. A link-state IGP that makes routing decisions based on the shortest-path-first (SPF) algorithm (also referred to as the *Dijkstra algorithm*).

P **package** A collection of files that make up a JUNOS software component.

Packet Forwarding Engine The architectural portion of the router that processes packets by forwarding them between input and output interfaces.

path attribute Information about a BGP route, such as the route origin, AS path, and next-hop router.

PCI Peripheral Component Interconnect. Standard, high-speed bus for connecting computer peripherals. Used on the Routing Engine.

PCMCIA Personal Computer Memory Card International Association. Industry group that promotes standards for credit card-size memory or I/O devices.

PDU Protocol data unit. IS-IS packets.

PE router Provider edge router. A router in the service provider's network that is connected to a customer edge (CE) device and that participates in a Layer 3 VPN.

PEC Policing Equivalence Classes. In traffic policing, a set of packets that is treated the same by the packet classifier.

peer An immediately adjacent router with which a protocol relationship has been established. Also called a *neighbor*.

PFE *See Packet Forwarding Engine*.

Physical Interface Card *See PIC*.

PIC Physical Interface Card. A network interface–specific card that can be installed on an FPC in the router.

PIM Protocol Independent Multicast. A protocol-independent multicast routing protocol. PIM Sparse Mode routes to multicast groups that might span wide-area and interdomain internets. PIM Dense Mode is a flood-and-prune protocol.

PLP Packet Loss Priority.

policing Applying rate limits on bandwidth and burst size for traffic on a particular interface.

policy The ability to define filters for network packets. Filters control which packets are accepted or forwarded, and they can also modify packet contents. Also called *routing policy*.

pop Removal of the last label, by a router, from a packet as it exits an MPLS domain.

PPP Point-to-Point Protocol. A link-layer protocol that provides multiprotocol encapsulation. It is used for link-layer and network-layer configuration.

preference Desirability of a route to become the active route. A route with a lower preference value is more likely to become the active route. The preference is an arbitrary value in the range 0 through 255 that the routing protocol process uses to rank routes received from different protocols, interfaces, or remote systems.

preferred address On an interface, the default local address used for packets sourced by the local router to destinations on the subnet.

primary address On an interface, the address used by default as the local address for broadcast and multicast packets sourced locally and sent out the interface.

primary interface Router interface that packets go out when no interface name is specified and when the destination address does not imply a particular outgoing interface.

Protocol-Independent Multicast *See PIM*.

provider edge router *See PE router*.

provider router   A router in the service provider's network that does not attach to a customer edge (CE) device.

PSNP   Partial sequence number PDU. A packet that contains only a partial list of the LSPs in the IS-IS link-state database.

push   Addition of a label or stack of labels, by a router, to a packet as it enters an MPLS domain.

Q

QoS   Quality of service. The performance, such as transmission rates and error rates, of a communications channel or system.

quality of service   *See QoS.*

R

RADIUS   Remote Authentication Dial-In User Service. An authentication method for validating users who attempt to access the router using Telnet.

Random Early Detection   *See RED.*

rate limiting   *See policing.*

RBOC   (pronounced are-bok) Regional bell operating company. The regional telephone companies formed as a result of the divestiture of the Bell System.

RED   Random Early Detection. A gradual drop profile for a given class that is used for congestion avoidance. RED tries to anticipate incipient congestion and reacts by dropping a small percentage of packets from the head of the queue to ensure that a queue never actually becomes congested.

Resource Reservation Protocol   *See RSVP.*

RFC   Request for comments.

RFI   Radio frequency interference.

RIP   Routing Information Protocol. Distance-vector interior gateway protocol that makes routing decisions based on hop count.

route flapping   Situation in which BGP systems send an excessive number of update messages to advertise network reachability information.

route identifier   IP address of the router from which a BGP, IGP, or OSPF packet originated.

route reflection   In BGP, configuring a group of routers into a cluster and having one system act as a route reflector, redistributing routes from outside the cluster to all routers in the cluster. Routers in a cluster do not need to be fully meshed.

router link advertisement   OSPF link-state advertisement flooded throughout a single area by all routers to describe the state and cost of the router's links to the area.

routing domain   *See AS.*

Routing Engine   Architectural portion of the router that handles all routing protocol processes, as well as other software processes that control the router's interfaces, some of the chassis components, system management, and user access to the router.

routing policy   *See policy.*

routing table   Common rpd database of routes learned from one or more routing protocols. All routes are maintained by the JUNOS routing protocol process.

rpd   JUNOS software routing protocol process. User-level background process responsible for starting, managing, and stopping the routing protocols on a Juniper Networks router.

RPM   Reverse path multicasting. Routing algorithm used by DVMRP to forward multicast traffic.

RSVP   Resource Reservation Protocol. Resource reservation setup protocol designed to interact with integrated services on the Internet.

S

SAP   Session Announcement Protocol. Used with multicast protocols to handle session conference announcements.

SAR   Segmentation and reassembly. Buffering used with ATM.

SCB   System Control Board. On an M40 router, the part of the Packet Forwarding Engine that performs route lookups, monitors system components, and controls FPC resets.

SDH   Synchronous Digital Hierarchy. CCITT variation of SONET standard.

SDP   Session Description Protocol. Used with multicast protocols to handle session conference announcements.

SDRAM   Synchronous Dynamic Random Access Memory.

SIF   SONET interoperability form. Created in 1994 to address the interoperability issues in SONET.

secure shell   *See SSH.*

SFM   Switching and Forwarding Module. On an M160 router, a component of the Packet Forwarding Engine that provides route lookup, filtering, and switching to FPCs.

shortest-path-first algorithm   *See SPF.*

signaled path   In traffic engineering, an explicit path; that is, a path determined using RSVP signaling. The ERO carried in the packets contains the explicit path information.

simplex interface   An interface that assumes that packets it receives from itself are the result of a software loopback process. The interface does not consider these packets when determining whether the interface is functional.

SNMP   Simple Network Management Protocol.

SONET   Synchronous Optical Network. High-speed (up to 2.5 Gbps) synchronous network specification developed by Bellcore and designed to run on optical fiber. STS-1 is the basic building block of SONET. Approved as an international standard in 1988. *See also SDH.*

SPF	Shortest-path first, an algorithm used by IS-IS and OSPF to make routing decisions based on the state of network links. Also called the *Dijkstra algorithm*.
SSB	System and Switch Board. On an M20 router, Packet Forwarding Engine component that performs route lookups and component monitoring and monitors FPC operation.
SSH	Secure shell. Software that provides a secured method of logging in to a remote network system.
SSRAM	Synchronous Static Random Access Memory.
static LSP	*See static path*.
static path	In the context of traffic engineering, a static route that requires hop-by-hop manual configuration. No signaling is used to create or maintain the path. Also called a *static LSP*.
STM	Synchronous Transport Module.
strict	In the context of traffic engineering, a route that must go directly to the next address in the path. (Definition from RFC 791, modified to fit LSPs.)
STS	Synchronous Transport Signal. Synchronous Transport Signal level 1. Basic building block signal of SONET, operating at 51.84 Mbps. Faster SONET rates are defined as STS-*n*, where *n* is a multiple of 51.84 Mbps. *See also SONET*.
stub area	In OSPF, an area through which, or into which, AS external advertisements are not flooded.
subnet mask	Number of bits of the network address used for host portion of a Class A, Class B, or Class C IP address.
summary link advertisement	OSPF link-statement advertisement flooded throughout the advertisement's associated areas by area border routers to describe the routes that they know about in other areas.
sysid	System identifier. Portion of the ISO nonclient peer. The sysid can be any 6 bytes that are unique throughout a domain.
System and Switch Board	*See SSB*.

T

TACACS +	Terminal Access Controller Access Control System Plus. Authentication method for validating users who attempt to access the router using Telnet.
TCP	Transmission Control Protocol.
ToS	Type of service.
traffic engineering	Process of selecting the paths chosen by data traffic in order to balance the traffic load on the various links, routers, and switches in the network. (Definition from http://www.ietf.org/internet-drafts/draft-ietf-mpls-framework-04.txt.) *See also MPLS*.
transit area	In OSPF, an area used to pass traffic from one adjacent area to the backbone or to another area if the backbone is more than two hops away from an area.
transit router	In MPLS, any intermediate router in the LSP between the ingress router and the egress router.

tunnel	Private, secure path through an otherwise public network.
type of service	*See ToS.*

U

unicast	Operation of sending network traffic from one network node to another individual network node.
UPS	Uninterruptible power supply.

V

VCI	Virtual circuit identifier. Identifier for an ATM virtual connection. Also called a *logical interface.*
virtual circuit identifier	*See VCI.*
virtual link	In OSPF, a link created between two routers that are part of the backbone but are not physically contiguous.
virtual path identifier	*See VCI.*
Virtual Router Redundancy Protocol	*See VRRP.*
VPI	*See VCI.*
VRRP	Virtual Router Redundancy Protocol. On Fast Ethernet and Gigabit Ethernet interfaces, allows you to configure virtual default routers.

W

wavelength-division multiplexing (WDM)	Technique for transmitting a mix of voice, data, and video over various wavelengths (colors) of light.
weighted round-robin	*See WRR.*
WRR	Weighted round-robin. Scheme used to decide the queue from which the next packet should be transmitted.

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